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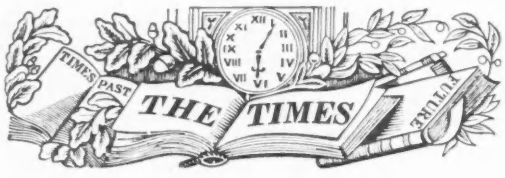

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The Healthiest People in the World

The hardy community on Tristan da Cunha

(The comforts of living according to Western civilization seem to bring their own special ills. In this article, the remote colony of Tristan is described with special reference to the physical well-being of the inhabitants. Dr S. D. Henriksen, medical investigator attached to the Norwegian Scientific Expedition, attributes their health and energy and excellent teeth to their pure but unrefined food.)

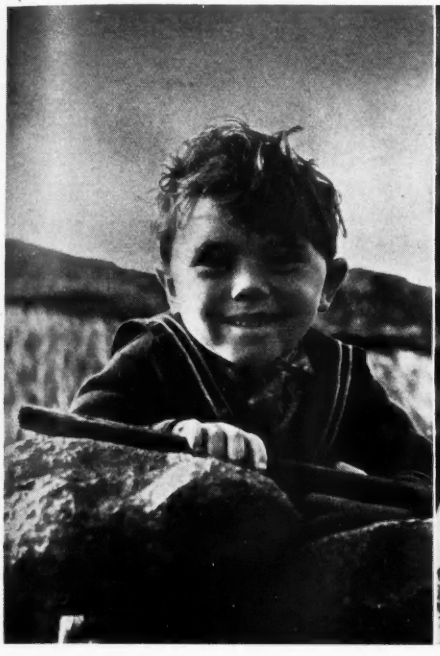
THE newspapers have now and then brought news from Tristan da Cunha, telling about an exceptionally healthy little community, free from all the serious diseases which ravage the civilized countries. The books and reports about the island and the islanders which have been published now and then —chiefly by missionaries and British naval surgeons—agree that the islanders can boast of a very good physique and an excellent condition of health. Most of the serious diseases which are only too prevalent in Europe and the other civilized parts of the world seem to be practically unknown. And, last but not least, the teeth of the islanders are said to be in an excellent condition—a fact which has repeatedly directed the attention of dentists in recent years to this little isolated island in the South Atlantic.

The little colony on Tristan, consequently, is more fortunate as regards the condition of health than their relations in England, Scotland, Holland, America, Italy, and on St Helena, where their ancestors came from. The reason why they can keep so healthy in a place that seems so little fit for human beings to live is

an interesting problem from a scientific point of view, and well worth studying, and an attempt to solve this problem was the aim of the medical section of the Norwegian scientific expedition to Tristan da Cunha.

It is, however, a rather difficult problem, as a lot of causal factors have to be taken into consideration, and put into correct relationship with one another: heredity, nutrition, habitation, and so on. As we had only three months to complete our investigations, we had to choose such scientific methods as could be expected to give a good crop of results in the shortest possible time; and, further, we had to omit all methods that could cause any pain or discomfort to the islanders, as we did not want to frighten or hurt them in any way. We could not expect them to look upon our examinations from our scientific point of view, and feared that they might get tired of us too soon if we bothered them overmuch.

But our experiences on Tristan taught us that there was no cause for our fears, and that the Tristanites were the best possible human material for a scientific investigation. They were not only willing to do anything for us and to pass through any sort of examination with a kind and smiling face, but they met us with such an extraordinary friendliness and kindness, that we had made the best of friends with every soul on the island before many weeks had passed. They also met us with great confidence, and seemed to be very thankful because we had taken the



trouble to come so far to occupy ourselves with their affairs. When one of the Tristanites had passed through a long and tiresome examination, he usually left us with a "thank you very much for all your kindness", and if we asked one of them a favour, the answer was invariably "only too pleased".

This extraordinary kindness and confidence is most characteristic of the Tristanites, and is due to the strong isolation of the community. They lead a simple life, far away from the troubles of other countries. There are no contrary group-interests on the island, and any kind of competition with other groups or communities is unknown to the Tristanites. Only three or four times a year a passing ship brings them into touch with the great outside world. How could they fear anything from other people, and why should they not be friendly to them? They hear of the struggle and fighting in other countries, and thank God that they live their peaceful life on Tristan.

It would be too much, however, to say that the Tristanites do not know the struggle for life. Tristan da Cunha is no Garden of Eden. The island is poor in natural resources, and the people have to work hard for their food, which, indeed, is not very varied. Flour and bread, sugar, condiments, and many other articles of food are more or less luxuries, and do not play any important part in their diet. The everyday menu is very often boiled fish and potatoes three times a day. Those

George, a faithful friend and excellent guide

who can afford it kill a sheep or a cow once in a while. But very few can afford it and most of them eat meat only at Christmas and other great festivals—and then it is chiefly mutton, very seldom beef. Even milk is rare. Usually they have only just enough to put in the tea. Many children on Tristan have never tasted milk.

There is a little variation in the diet in some seasons of the year. In the summer they have a few vegetables and wild berries, in the autumn apples and now and then a young albatross, and in the nesting season in the spring they eat lots of seabirds' eggs; indeed, for a few weeks their diet consists almost entirely of eggs.

But the Tristanites are easily contented. We often asked the islanders if they ever tired of fish and potatoes every day; they always smilingly replied that they were used to it. Isolation and lack of competitive spirit have made them not only peaceful and full of confidence to other people, but even somewhat careless in their own affairs. They are happy and content, and do not feel impelled to improve their own standard of living in any way. They are conservative by nature.

It is not only because of lack of knowledge, therefore, that agriculture is extremely primitive. The islanders do little for their domestic animals, which are left entirely alone, and in the winter have to endure extreme hardship and even starvation. Corn is not grown, the islanders say, on account of the rats that came ashore from a wreck some fifty years ago. Before that time they used to grow a little corn, but not enough for their own use. In those days sailing vessels very often visited the island to get fresh water, meat, and vegetables, and the islanders seemed to prefer to buy flour from them rather than grow corn themselves. And that is what they still want to do, but nowadays there is hardly a sailing vessel on the seas, and steamers call only seldom.

Potatoes are grown on the west side of the island a few miles away from the settlement, where the soil is good. There are hundreds of small patches separated by stone walls without any gates, and one has to climb one wall after the other to reach the central patches. The first purpose of these walls is to protect the potato plants against cattle and the wind which causes so much trouble to agriculture on Tristan; and the second reason for the walls is that, although the ground is free

and belongs "to the island" as long as it is open, it is considered to be the private property of any man who fences in a patch with a stone wall, as long as he keeps the wall up.

There is still plenty of free ground that could be cultivated, but the islanders do not grow more potatoes than will just last them through the winter—when the crop is good. On the whole there are only 20 to 25 acres of land under cultivation, but there are sometimes bad years on Tristan. One year the hailstorms will break down the young plants, another year the "grubs", a kind of big black worm, will eat off all the leaves. This year both happened, and the crop is definitely too small to last through the winter. But even such serious circumstances are unable to diminish the feeling of happiness and the good humour of the islanders. They are used to it, and talk about the coming hardships with a smile. They trust that the fish will keep them from starving, and easily forget that in the winter the storms will be raging, and that it may be impossible to put out a boat from the beach for weeks. In bad weather and with no potatoes in the bins they must starve. But Tristan people seem to get used to starvation too.

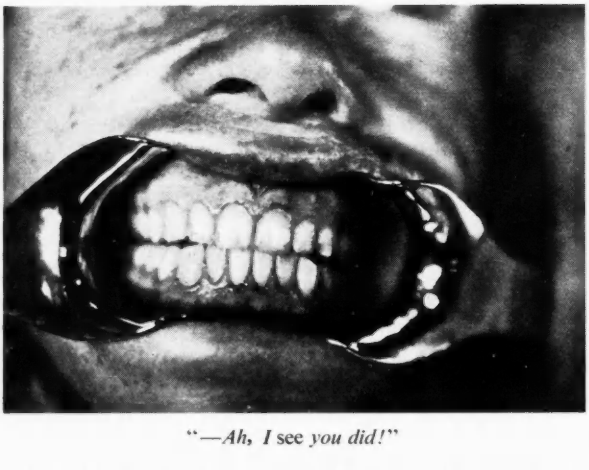
Actually all the people on Tristan are poor, but there are some people who own more cattle and sheep than others. That is how they estimate their "property". There is no currency, and the ground that they cultivate is not reckoned as a part of their property, but in spite of the fact that some have more than others, there is, nevertheless, no actual differentiation in class. They are all on the same social level, and they have all the same struggle to make a good living. It is characteristic that extreme poverty is always due to laziness and carelessness. For them, poverty is always self-inflicted, and

(Above) Frances Repetto, the chief woman
(Below) Old Sam, one of the finest characters of Tristan

the poor, therefore, are disdained by those who look ahead and work hard. But they always help each other when necessary.

On the whole the Tristanites are hard-working people, and most of them have a strong feeling of responsibility for their families. From previous reports we had often heard that the people are degenerating, due to intermarriage, but we were surprised to find a mentally as well as physically strong and healthy society, and no trace of degeneration could be found. They are clever boat-builders and excellent sailors, though they know nothing about navigation.

Our first impression of the physical strength of the Tristan men was very favourable. They carried our heavy flour barrels with a smile, and rolled large drums of oil as if it was good sport. One man particularly, old John Glass, a grandson of the first settler, caught our attention. He was eager to get hold of the heaviest things, and worked with such an energy that we were very surprised when we heard he was nearly 70 years old. And later examinations confirmed our first impression. Most of the men on Tristan are well built with strong muscles; some are real athletes, capable of any amount of hard work. The strongest among them were, besides old John Glass, the headman Willie Repetto and his brother Arthur. Fortunately the headman is a very good-natured man, and he was glad to help us in every possible manner.



"—*Ah, I* see *you did!*"

The women also are well built, slender but strong. Some of them are a little too lean, but nearly all are healthy. The children are more unevenly developed—some of them are of a normal degree of development for their age, but others, chiefly from the poorest families, seem to be a little late in developing, small for their age and—at least in some cases—definitely under-nourished. But they are a merry lot, as full of fun and mischief as children anywhere, and, like the grown-up people, they are very fond of a joke, and hardly ever did we see one of them without a smile. They usually got a little piece of chocolate when we had finished our examinations, which were consequently very popular among them, as chocolate is an almost unheard-of luxury on Tristan.

A few days after our arrival all the islanders got a cold. This is quite typical of Tristan. Every time a ship from South Africa calls at Tristan such an epidemic

goes all over the settlement, but, strangely enough, not after the call of a ship which has been on the high seas for a long time, as, for instance, Norwegian whalers which call on their way home from the catching fields. Such epidemics of colds seem to occur on many similarly isolated places, Greenland and Spitzbergen, and among the offspring of the "Bounty" men on Pitcairn.

The general condition of health on Tristan is good. We found no traces of diseases of the kidneys, serious rheumatic diseases, infectious diseases, tuberculosis or venereal diseases. Only four people reacted positively to tuberculin, and all of them had stayed in the outside world for many years—all of them, however, more than thirty years ago. Only one man suffered from a serious gastric disease, and he had been living in South Africa for fifteen years. Only two men and one woman suffered from high blood pressure, and both the men had lived away from Tristan for years.

The only diseases which are common on Tristan are the so-called allergic diseases, which are due to hypersensitivity to foreign proteins, viz. asthma, migraine, eczema and hay fever. These ailments obviously depend upon hereditary dispositions, and not upon the rough Tristan climate, since we could trace these diseases in some families for several generations. They were probably imported by a woman from St Helena and an American whaler. The most common complaint besides the allergic diseases is rupture, probably a consequence of the hard work.

It seems justifiable to conclude that the diseases which occur on Tristan are either due to hereditary factors or to hard work, while other diseases, due to infection, unsatisfactory food or lack of important components (vitamins, minerals), do not occur.

The condition of the teeth is equally satisfactory. Only a comparatively small proportion of the population suffers from dental decay, and this usually occurs as very small cavities, which often seem to stop developing before causing toothache. But as soon as the Tristanites leave their island they get as much decay as anybody else. We met several Tristanites in Cape Town who had false teeth, and several of the people on Tristan who suffered from dental caries had been staying in South Africa for a long time. It is worth mentioning that the mothers on Tristan suffered most from dental decay—a few of them even from toothache.

We performed bacteriological examinations of the saliva of most of the inhabitants, and we succeeded in showing that a microbe, which has been claimed to be the cause of caries, existed in the mouths of those who suffered from this bone disease, while the mouths of the others appeared to be completely free from the microbe. It is interesting that we could confirm the statements—chiefly from American quarters—concerning the frequency of this microbe, the so-called *B. acidophilus*, in caries, but, of course, the material is far too small to justify any conclusions as regards the importance of this microbe as a causal factor.

It seems to be natural to suppose that the good state of health on Tristan is due to the conditions of life, chiefly the nutrition. It may seem strange that the islanders can keep their teeth in so good a condition on such a poor and monotonous diet, but it may be an important point that all the articles of food eaten on Tristan are quite pure, in the natural state, and that no refined articles of food are used to any extent. The food is very soft and does not give the teeth hard work. Even the oldest inhabitant, old Sam Swain, who is eighty years old and has all his teeth, has not worn them down appreciably.*

During our stay on Tristan we were able to collect a good deal of information, and we brought a lot of material home; X-ray pictures, impressions of teeth, specimens of the different articles of food, and so on, and we shall be busy for some time before we can draw any final conclusions. But, whatever these may be, we have at any rate collected a lot of memories from a very interesting place and a kind and charming people, and it will be a great pleasure to us if our work is of some use to our friends on Tristan da Cunha.

S. D. HENRIKSEN
P. A. MUNCH

* It is interesting to note that the inhabitants of Pitcairn Island almost all have particularly bad teeth. This may be due to a genetic dominant strain; Edward Young, of the original "Bounty" mutineers, appears to have lost his teeth in the early twenties. Editor, *Discovery*.

The Healing of the Split Mind

By JOHN YUDKIN

THROUGHOUT the Middle Ages and even later, disease of the mind was considered to be outside the domain of the physician. The insane were looked upon as being "possessed" or bewitched, and they were treated with considerable harshness and lack of sympathy. It is only in comparatively recent times that these unfortunate individuals have been treated with the understanding and insight which sufferers of the diseases of the body have learned to expect from their doctors. Even now, the social stigma of mental disorder still remains in the minds of most laymen and even some doctors. Hence, many early cases of insanity which might be improved or even completely cured by treatment are allowed to progress to the state of permanent crippling of the mind.

The growing appreciation of insanity as a disease process analogous to that of the more readily understood bodily diseases has resulted in a great increase in the number of cases at present being treated in mental homes and asylums throughout the country. This rapidly rising population of our mental institutions has alarmed many who have taken it to indicate an increase in the degree of insanity in the community, and one is accustomed to hear of the toll in human mental sickness which is being paid as the price for the speed and intensity of living which have accompanied progress. It is not easy to assess the amount of mental ill-health in a community which regards it as a thing to be hidden and of which to be ashamed but, as far as can be calculated, such fears of a rapidly increasing amount of insanity are quite groundless. The growing number of cases now in institutions is a sign only of a greater understanding of the need for their proper treatment.

It is with reason that I use the word "treatment". The mental home is to many an institution mainly for the benefit of the social community, in particular the relatives and friends of the patient. Here the patient is incarcerated until such time as he is sufficiently "normal" to be allowed his freedom. When this event will occur, or whether it will occur at all, appears to most people as a matter of complete chance.

But such a view of mental disease is incorrect. It is another aspect of the popular idea that mental and physical diseases are completely different in nature, requiring an entirely different attitude of approach. It is usual, for example, to speak of insanity as if it were a single disease entity. But the mind, like any other organ, may be diseased by a variety of means and in a variety of ways. To say that heart disease is "serious" or "incurable" is meaningless, for there are many different diseases of the heart, each of which has its own particular treatment and "prognosis" or outlook. Similarly, insanity embraces a variety of distinct diseases, each with its own chances of cure, of gradual deterioration or of permanence.

It is true that a doctor is often loath to express his opinion as to the chances of cure in any particular instance. In cases where the doctor has to make a definite statement, it is usual for medical opinion to be expressed as "incurably insane in the light of present medical knowledge". Of course, as with every disease, it is sometimes difficult to forecast progress in an individual

case. And, as we shall see, treatment of certain mental conditions has recently advanced considerably. But, often, the cautious statement of medical opinion is a safeguard for the practitioner himself rather than real uncertainty as to the progress of an unfortunate case of advanced disease, for an insane person whose condition improves sufficiently for him to be allowed his freedom can fairly readily recover enormous sums of money as damages against the doctor responsible for his certification.

One of the defined diseases of the mind is that of schizophrenia or dementia praecox. The latter name indicates its common occurrence in young individuals of about twenty years. The term schizophrenia and its lay equivalent "split mind" recalls its chief characteristic, the tendency of the victim of the disease to withdraw from reality into a life of fantasy of his own creating. There is often, though not always, a hereditary factor. Often, too, there is a history of some mental or physical shock or illness. But, apart from this, very little is known concerning the causation of the disease. Its choice of victims is particularly ironical—they are frequently of more than average intelligence and ability, and the early age of onset often means that the victim is at a stage where he is at the threshold of what promises to be an exceptionally successful career. The onset of the disease is usually quite gradual so that it may be difficult to say exactly when it commenced. For this reason too it is commoner for friends to notice the change in the character of the victim than the parents and the near relatives who, being more constantly with him, are prone to overlook the change until it becomes profound. The disease gradually progresses and the patient may be noticed performing odd actions, such as turning slowly round in one corner of the room, or grimacing in an extraordinary manner, or performing curious, stereotyped movements. On questioning, he will often say that he sees bright lights or images. He has fleeting and usually quite bizarre and illogical delusions. He is difficult to approach, both mentally and physically; he will draw away when one attempts to go near him and will not readily answer questions. But if one persists, it is possible to converse with him and it is then that the characteristic schizophrenia—splitting of the mind—is seen. He will frequently acknowledge if pressed that he is in a mental hospital but this does not annoy or even interest him. If one allows him to speak freely, he will say that he is really someone else and may speak in a different manner or even in a foreign language if this is known to him. And throughout he will periodically perform his own particular little tricks, perhaps bowing three times and then stamping three times with each foot in turn. Many show a curious wax-like flexibility of the limbs; one may bend them into any position and this will be maintained for hours.

These phenomena represent the early stages of the disease. In a small number of cases, the disease may die out spontaneously, but in the majority there is a gradual mental deterioration. The patient becomes more and more difficult to approach until finally he leads the simple, almost vegetable existence of dementia; the final stage of every persistent mental disease. An occasional hint of the schizophrenic malady may sometimes be seen in an odd grimace or series of movements, but in the last stages, one cannot differentiate between his behaviour and that of any other type of long-standing and persistent insanity.

Many are the attempted modes of treatment of this condition. Thus operations such as the removal of the thyroid gland, the injection of countless drugs and sera, psychotherapy, the production of mild illness in much the same way as malaria has been used to treat general syphilitic paralysis—all these have been tried and given up. None of them has been any more successful than the general nursing and care which are available in the mental hospital. The number of "complete re-

missions" or "spontaneous cures", in which the patient is really able to resume a normal social life, is about 20%.

In recent years a new and extraordinary treatment of schizophrenia has been evolved. It is the use of large—one might even say dangerously large—doses of insulin. It will be remembered that insulin is a hormone, produced by the pancreas, which is responsible for the proper utilization of blood sugar (glucose) by the body. Diabetics have an insufficiency of this hormone, so that they cannot properly metabolize glucose. This leads to an excessive amount of sugar in the blood and some escapes into the urine. The injection of insulin into a diabetic restores his ability to utilize glucose and the level of the sugar in his blood falls. If an excess of insulin is injected into a diabetic, or if insulin is injected into a healthy individual, the level of the blood glucose falls below its normal value. This fall is accompanied by a number of manifestations, the type and degree of which depend, of course, on the extent of the lowering of the blood glucose. Early there is a feeling of faintness, weakness and hunger, and the individual looks ill and pale. He perspires and becomes drowsy and restless. Later, there is the stage of "hypoglycaemic shock" in which there is excessive movement and perhaps convulsions which may resemble an epileptic fit. Eventually he passes into a deep coma and, if the dose of insulin is large enough, this will end in death.

Now small doses of insulin are frequently used in diseases other than diabetes. For example, the feeling of hunger experienced when the blood glucose falls is the rationale of the use of the hormone in patients in whom it is important to improve the appetite and increase their nourishment. For reasons of this sort, several sporadic reports have appeared during the last ten years of the use of insulin in certain cases of schizophrenia, but it must again be emphasized that, in these cases, only small doses of insulin were used, much too small to produce any violent reaction. The results of such treatment were satisfactory in that the general condition of the patient frequently improved, but fundamental improvement in the patient's mental state did not occur nor indeed was it looked for.

The treatment of schizophrenia with large doses of insulin "shock" doses was first reported towards the end of 1934 by Dr Manfred Sakel of Vienna. The form of the treatment is as follows. As soon as the disease has been diagnosed, the patient begins to receive injections of insulin in increasing quantities each morning. From the beginning of the injection until he has completely recovered from the effects of the insulin he is in a special ward under the supervision of a specially trained nursing staff. The injections are gradually increased until the "shock" dose is reached. The "shock" dose is repeated each day for a variable length of time—usually four to six weeks—and then a slightly smaller dose of insulin is given each day until the patient is discharged.

We have seen that hypoglycaemic shock is accompanied by a number of ill effects; weakness, extreme hunger, restlessness, fits, and so on. But one of the most interesting things about this treatment is that there is a complete loss of memory for these events, from the onset of shock, throughout the two hours during which the shock lasts, and often for several hours after recovery. On many occasions, the patient recovering from the shock will complain of feeling ill and shaky, but an hour or so later he will have forgotten this completely.

Sometimes, a patient will show excessive reactions. It is impossible entirely to avoid these because patients differ tremendously in the degree to which they react to certain doses of insulin. Often, too, the patient will react differently on different days, so that a dose which on several successive days has produced a slight shock may then result in an abnormally severe reaction. Whenever this occurs, the shock is ended at once by giving glucose to the patient.

It will be seen from this that the treat-

ment is exceedingly heroic. The patient is consciously and repeatedly put into danger of his life. One is reminded of the racks and whirling chairs which were used in the attempts to exorcize the devil from the bodies of the miserable victims of insanity of those times.

Some tragedies have unfortunately occurred; a few patients have died in the process of treatment. But these have been very few indeed—about 1% of the total of those treated, which is roughly the direct mortality rate of any major operation. And in view of the nature of the disease being treated, such a risk is surely worth taking.

Exactly what led Dr Sakel to try this alarming treatment is a mystery. No one previously had ever used "shock" doses of insulin in the treatment of any disease. Dr Sakel himself had had great success in treating morphia addicts with *small* doses of insulin, but he had never intentionally used doses sufficient to cause hypoglycaemic shock. In fact, a careful watch was always kept on those cases undergoing treatment for morphia addiction, in order to prevent, and if necessary treat at once, the slightest manifestations of shock. The use of the shock appears still more extraordinary in view of the fact that post-mortem investigations on animals which had been treated with large doses of insulin, or on patients who had died, by inadvertently taking too much insulin, showed that there was a definite and marked damage to the brain. It is not surprising that when Dr Sakel began to report on his treatment, there was a great deal of criticism from many eminent psychiatrists. But it does appear that the ends in this case have justified the means. None of those schizophrenic patients who have been treated and have recovered—and there are now some thousands of these—shows any signs of damage to their brain or nervous systems. The results of the insulin shock treatment of schizophrenia which have so far been reported show a great increase in the recovery rate, particularly in cases which have been treated at an early stage of the disease. Dr Sakel's first results showed that of patients treated within six months of the onset of the disease, 70% were completely cured and a further 18% were substantionally improved. Cases of older standing showed 20% of complete cures and a further 28% showed a marked improvement. Dr Mueller, working in Switzerland, then reported that 50% of all cases, old and new, were completely cured whilst a further 27% were improved. Compare these figures with those of untreated cases, where not more than 30% of early cases and about 10% of long-standing cases recover. Since these early reports several hundreds of cases have been treated with very similar results.

The results of insulin shock therapy in schizophrenia have recently led to the use of other substances which would produce similar effects. Certain drugs have been chosen, such as cardiazol and triazol, and injection of which produces convulsions similar to those produced by insulin. As far as can at present be judged, these drugs although they appear to act, are not so effective as insulin. Dr Sakel's most recent report refers to the use of these drugs in cases in which insulin has produced no effect. It appears that some cases not benefited by insulin do show an improvement with cardiazol and similar substances.

Let me quote some of the individual cases which have been reported and which show the remarkable effects sometimes seen during the treatment. One was a man of 28, who had been a brilliant student. For many years, however, he had been insane; he was often violent and on several occasions insisted that he was the Angel Gabriel. He moved his hands in the typical stereotyped fashion of the schizophrenic. He was treated with shock doses of insulin for about four weeks and appeared to make no progress. Then suddenly he improved and after a further fortnight he was discharged from hospital "absolutely clear mentally...with not the least sign of a present or even of a past psychosis". A second case was of a man who for two

years had been sitting in a dazed fashion, with his head bowed and completely unoccupied. At the end of his treatment, he was examined by a doctor who reported, "I can find no abnormality in him." Another patient, a girl of 19, had been ill for nearly a year and showed the extreme apathy and stiffness of movement often found in schizophrenics. Although she had had several different types of treatment she steadily became worse and by the time the insulin treatment was started, she refused to eat and had to be fed by a tube. The onset of the treatment was followed by a remarkable improvement and on stopping the treatment in the early stages on two occasions for a short while, she returned to her previous condition. After this, the treatment was carried on and she gradually and steadily improved. Soon she was conversing with her nurses and reading books and she was later discharged "in full mental health".

It will be some time before we can really decide as to the exact benefit of these new treatments and particularly as to the permanence of the cure. But it cannot be doubted that, in the treatment of this one type of mental disease, the results of "shock" therapy are more than encouraging.

Fog remains one of the worst of weather conditions for flying. This article describes the latest method of wireless guidance for aeroplanes by means of signals sent out from landing grounds in foggy weather.

Safe Landing in Fog

By R. QUARENDON

FOG is one of the biggest obstacles in the development of commercial aviation. Aeroplanes frequently have to be diverted to other landing grounds when fog envelops the airport for which they are bound, and it is not unknown for pilots to resort to their parachutes when unable to land. Many efforts have been made to solve the problem. Most of them consist of attempts to disperse the fog. The Aeronautical Research Council is reported to be experimenting with big heaters for this purpose.

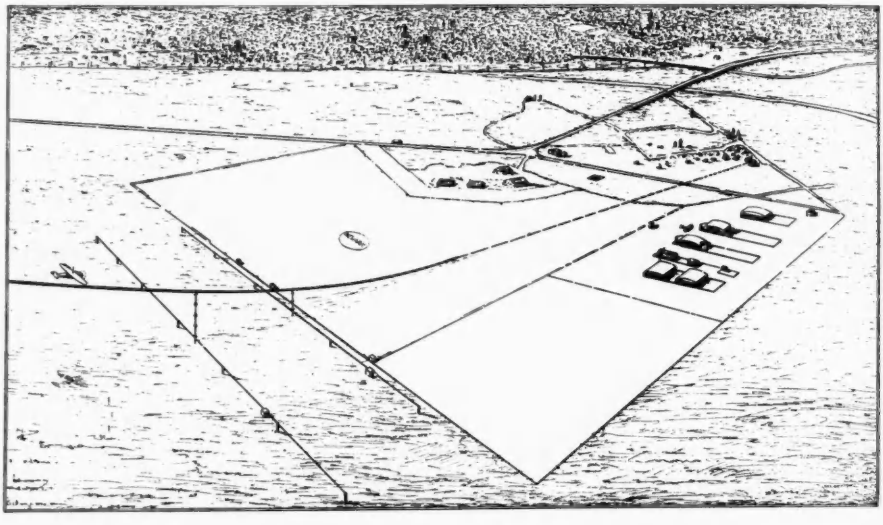
Scientists at the Massachusetts Institute of Technology have been working for the last four years on a method for the removal of fog by a spray of calcium chloride solution and consider it to be a practicable method. Another method which has been tried with some success is the precipitation of the fog particles by an electric discharge, either from a high tower or by means of charged sand. It has been suggested that the fog could be sucked into underground channels by means of powerful fans.

Although these methods have possibilities, the way which shows the most promise is not to remove the fog but to render the pilot independent of fog. Remarkable results, in which aeroplanes have been guided to earth through thick fog, have been achieved with systems using radio waves. Several countries are now experimenting with this method of "blind approach". At least one of these systems has been developed to the point where it can be definitely considered a commercial success. Numerous continental airports, and some in America, Africa and this country, have been equipped with the

necessary apparatus, which is adding enormously to the safety of air travel.

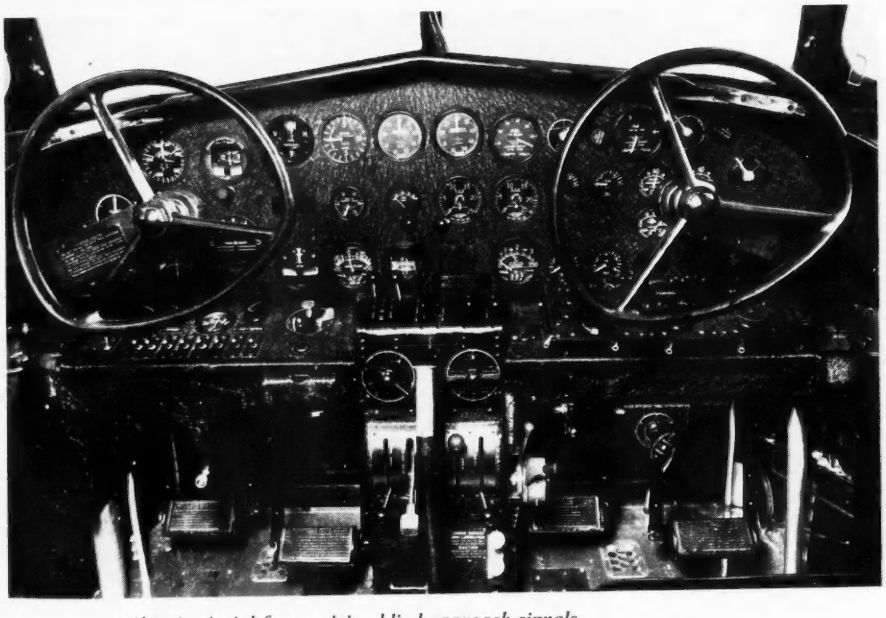
In order to bring a plane safely to earth a pilot must have accurate information on four points. Obviously he must know when he is in the vicinity of the particular aerodrome he is seeking. He gets this information by signals from the ordinary range beacon, which he receives on the wireless set normally used for picking up weather reports. He must also know how far he is from the boundaries of the airport; how he is situated in a sideways direction with regard to the runway on which he intends to land; and how far he is above the ground. Radio blind-approach equipment gives him this information and translates it into movements of pointers across dials, which can be observed, and with the help of audible signals, followed almost automatically. It does even more than this, it actually marks out the path in space best suited to the conditions at the aerodrome and to the aircraft, and the pilot is thus largely relieved of the strain of having to exercise his own judgment in very difficult circumstances.

To follow what happens, we must imagine a long rope hanging in an enormous curve in the air. This hypothetical rope is attached at one end to the airport landing ground and is suspended from a point in the air some 5 miles away and, say, 5000 ft. high at the other. If the nose of the aeroplane were attached by a ring which could slide along the rope, it would follow the curve until it reached the ground. In his cabin the pilot has a special receiving set and instruments which tell him when he is wandering to one side or the other of the "rope" and when he is falling above it. The path marked out in space is confined to an angle of 6 degrees, giving the aeroplane a sideway latitude of 1320 ft. at 5 miles, but only about 45 ft. when he is over the airport boundary. The path is defined by means of ultra high-frequency radio waves. These are used because they are least affected by the ground and by atmospheric conditions, thus ensuring maximum safety.



Sketch showing landing path and position of marker signals at Newark Airport, U.S.A.

Those who know anything of the principles of radio diffusion will want to know



(*Above*) *Aerial for receiving blind-approach signals*
(*Below*) *Visual indicator is shown immediately on right of the left wheel*

how it is possible to mark out such a narrow path when the waves travel outwards in all directions. Avoiding a too-technical explanation it can be said that the solution lies in the use of "polarized" waves, which are effective only in a horizontal or a vertical plane, as the case may be.

Let us look at the little sketch in Fig. 1 and imagine we are gazing down at the earth. The broken and dotted ellipses show the path of the waves produced in rapid succession from an aerial coupled alternately with either of two reflectors. The only direction in which both these radio signals can appear equally loud *all* the time is the one midway between these two ellipses. This is the direction which the aeroplane follows. Matters are so arranged that one reflector sends out dashes and the other one sends out dots, which the pilot hears when he tunes in to the airport. If the dashes are the louder, he knows he is too far to starboard, while if dots predominate then he is too far to port. His object is to steer a course along which dots and dashes blend into one another and become practically indistinguishable, when he knows he is "on course". Besides the audible signals, the pilot is guided by the movement of a pointer over a dial. When the pointer is vertical the plane is following the right course. When it moves to the right or left, the plane is off course, and must be manœuvred in the direction the pointer indicates.

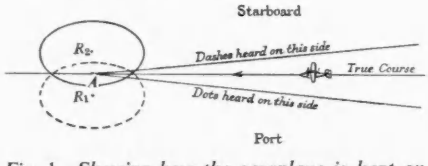


Fig. 1. Showing how the aeroplane is kept on its proper course towards the landing ground by radio signals consisting of dots and dashes.

A = Aerial; R_1 and R_2 = Reflectors operating alternately. Ellipses show path of radio waves.

So much for the way the pilot is directed *towards* the landing ground. How does he lose height at the correct rate to clear the obstacles in his path and make a good landing?

To follow our imaginary rope in a downward direction, we again make use of constant signal strength emitted by the main beacon along an elliptical path, but in this case, the ellipse cuts out a *vertical* slice through space. Thus when the pilot begins his downward glide to earth all he has to do is to follow the path which produces a constant response in his receiver. This path is shown in Fig. 2. Again

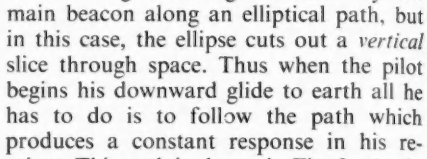


Fig. 2. Showing path of guide beam and marker beacon signals.

a pointer gives him the desired information, but in this case, it moves up or down instead of sideways.

German and American engineers have different ideas on the method of defining these paths in space. The former use one transmitter only, working on a wave-length of 9 m. for both the horizontal and the vertical direction finding. The latter use two transmitters, one working on a wave-length of 750–1500 m. for horizontal navigation, the other operating on the ultra short wave-length of 3·3 m. for vertical navigation.

The indicating instruments designed by the American engineers are very cleverly arranged. Both pointers are mounted on the same dial, and all the pilot has to do is to watch the point of intersection. If the pointers cross in the centre of the dial, he knows he is on the right path both vertically and horizontally. If they intersect at some other point, then he must alter his course suitably. This arrangement relieves the pilot of the strain of watching two instruments at the same time.

When the aeroplane approaches the outskirts of the airport, the pilot must be

told his distance from the landing ground more precisely than he can learn it from his distance meter. He receives this information from two marker beacons, each of which emits a narrow wall of radio signals through which the aeroplane flies. When he passes the first of these positions, about a mile from the landing point and 600 ft. above the ground he hears a high-pitched note in the earphones. At the same time a light flashes on the instrument board before him. He knows then that he is on the last stage of his journey. Six seconds later, when he is right above the airport boundary, he hears a low-pitched note, and another light flashes. He is then a mere 30 ft. up. He eases the stick back a little and before he realizes it he has come safely to earth.

It might be thought that pilots would be confused by the multiplicity of signals they pick up in their earphones. In practice this difficulty does not arise. Each one is quite distinctive and the marker beacon signals last only a very short time.

It is remarkable with what accuracy a given course can be adhered to. At one airport the glide path passes only 8 ft. above a chimney distant 1500 ft. from the edge of the field. That chimney is still undamaged! Over the edge of the field, when the plane is about 30 ft. above the ground, a change of height of 5 ft. can be easily detected while the possible error in a sideways direction is only about 20 ft.

A pilot with some knowledge of flying with the aid of instruments soon learns how to make a completely blind landing. Colonel Lindbergh made two landings, with the cockpit completely enclosed, with no previous experience.

A marker beacon aerial with transmitter hut and reflector

The Equation of Time

By R. v. d. R. Woolley

(Why do the afternoons begin to lengthen several days before the shortest day? A reader asks this question, pointing out that this happens about ten days before the solstice in our latitude, but that in lower latitudes the interval is even longer. Dr R. v. d. R. Woolley of the Observatory, Cambridge, answers the question in the following article.)

TO put a name to the phenomenon does not explain it. It is necessary to go into the question of timekeeping in some detail. For scientific purposes we require some sort of uniform timekeeper: without venturing into awkward philosophical or metaphysical questions as to what is meant by that phrase, we can safely appeal for the purposes of this article to the reader's idea of a perfect mechanical clock. For scientific purposes it will not matter how the clock is calibrated, that is to say, what is the hour or unit of time. Just as the metre is the distance between two marks on a certain bar kept in the archives at Paris, the hour might be the time taken for the hands of the standard clock in the vaults at Paris (or anywhere else selected by international agreement) to pass from one mark to another. But for civil purposes, it is clearly desirable that the unit of time should have some simple relation to our daily life—so that the office always opens at x o'clock, and the train home departs at y hours z minutes, the x, y and z referring always to certain times of day. Civil requirements dictated the measurement of time in terms of the day and night, and, as is well known, the system of dividing day plus night into 24 hours has been universally adopted. No difficulty was experienced until accurate clocks were constructed, when it was found that the interval between midday and midday judged by the sundial is not always the same length of time judged by the clock. The sun is sometimes early and sometimes late on the perfect clock. The same is not true of the stars, however. If there was a star bright enough to cast a shadow on a sundial, the interval between successive indications of 12 o'clock star time would agree perfectly with equal intervals on a mechanical clock—but the intervals would not be days. This is because the earth goes round the sun in such a sense that, as it turns on its axis $366\frac{1}{4}$ times in one year, the revolution round the sun makes the sun appear to rise and set once less or $365\frac{1}{4}$ times per year. Hence there are $365\frac{1}{4}$ ordinary days and $366\frac{1}{4}$ sidereal days in a year, and the sidereal day is about 4 minutes shorter than the solar day. It is no good using sidereal time for civil purposes, because 6 o'clock sidereal time occurs in the evening in the autumn, at midday in winter, in the early morning in spring and at midnight in summer. If we kept sidereal time on our clocks we should be faced with the choice of having the morning train to town running

4 minutes later each day, or of following the indicated time and lunching at midnight at some time of the year. We prefer, of course, to take no notice of astronomical nonsense, to use a time which agrees more or less with solar time, but to keep it on perfect mechanical clocks and to disregard the fact that 12 o'clock clock time is not always 12 o'clock sundial time. The difference between sundial time and civil time is called the Equation of Time. It is quite large. On 1 January, solar time is 3 minutes behind civil time; in the first week in February, it is 14 minutes behind; on 16 April they coincide, and by 16 May solar time has got $3\frac{3}{4}$ minutes ahead. From this date however it falls back, the two time systems being coincident on 14 June. Late in July the solar time is 6 minutes behind civil time, and it starts to gain again, its biggest lead being 16 minutes 22 seconds on 4 November. From this date until February solar time loses on civil time.

We can now see why the equation of time comes into our correspondent's question. Midday by the sundial occurs at 11.44 a.m. on 4 November, at 11.51 a.m. on 1 December, at 11.58 a.m. on 21 December and at noon on Christmas Day. If the sun always set six hours after noon sunset would move from 5.44 p.m. on 4 November to 6 p.m. on Christmas Day, that is to say, on account of the Equation of Time alone the clock time of sunset gets a little later each day at this time of year, sunrise getting earlier, so that to people who were not up and about at sunrise the day would appear to lengthen. But in fact the sun does not set 6 hours after noon, but by an amount after noon depending on the time of year, coming to a minimum on the true shortest day, so that there are two factors determining the time of sunset, the length of the day and the Equation of Time, and these work against each other in early December, the shortening of the day tending to make sunset earlier and the equation of time tending to make it later. The total result of this is to make the earliest sunset come before the shortest day, and the effect is compensated at sunrise. A milkman who finished work and went to bed at noon would find the latest sunrise would occur *after* the shortest day in the almanacs.

One can see further that as one goes south to lower latitudes, the variation of the length of the day is weaker, so that the Equation of Time is more successful in pushing the date of earliest clock time of sunset forward in the month of December: conversely in high latitudes getting near the Arctic Circle the natural variation in the length of the day will be stronger and will mask the Equation of Time effect up to a later date than it does in these latitudes.

It is hardly fair to leave the matter here without a word about the origin of the Equation of Time itself. It has a double origin, and arises partly because the earth's axis is inclined to the axis of the earth's orbit, and partly because the earth's orbit is elliptical and not circular. The explanation of the way in which these two factors enter into the Equation of Time is a little too mathematical for us to embark upon it at the end of an article, but perhaps the part due to the elliptical motion of the earth is fairly obvious. It is only in a circular orbit that a satellite revolves

at a constant angular velocity round its primary, so that as the earth's orbit of revolution round the sun is slightly elliptical, the sun's movement against the background of stars is not uniform. This means that the rate at which apparent solar time is losing on sidereal time (and therefore on mechanical clock time) is not steady, and we have part of the cause of the Equation of Time.

Sir William Herschel

By C. D. Dimsdale

(Sir William Herschel, one of the greatest astronomers, was born two hundred years ago this month)

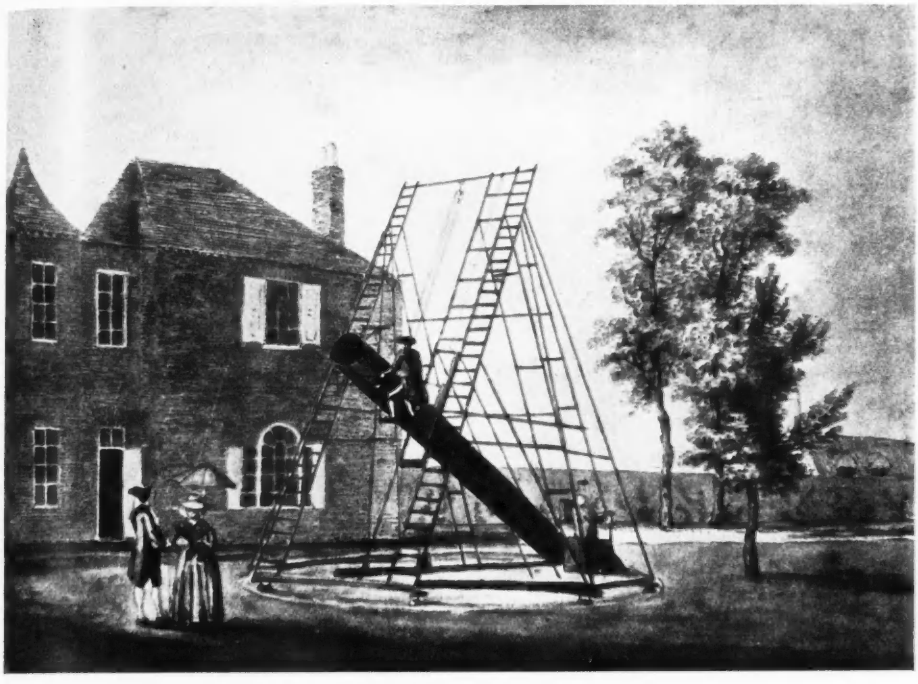
Sir William Herschel, who was born in Hanover in November 1738, had settled in England as a musician before he was twenty, and in 1766 went to Bath where he obtained his first important post. He had been made organist at the fashionable Octagon chapel in Bath, and it seemed that his career as a musician was established. He wrote cheerfully home to his anxious family in Germany and at last induced his cautious sister Caroline to come and live with him. He needed a capable housekeeper who understood him, for salaries and fees were small in those days and his time was full. He composed and conducted as well as taught music, at the same time resuming a youthful study of mathematics, which was associated in his zealous mind not only with music but with the newly fashionable sciences of optics and astronomy, a development that Sir Isaac Newton's work and fame had greatly encouraged.

As he grew keener in his new hobby of constructing a telescope because he could not get a good one from the London opticians at a price within his means, his rooms became ever more like a workshop. His leisure from music was spent in studying theories of optics, and in the laborious and skilled work of grinding specula and polishing lenses. Few of his friends and acquaintances, knowing him as a distinguished musician, realized the growing importance of his hobby. In 1774 he was able to examine the heavens with the first instrument of his own making, and thereafter he never rested in the endeavour to make improvements to the instrument.

With extraordinary mental and physical energy, to which was added the finest skill and intelligence, Herschel so pursued his new careers as optician and astronomer, that within two decades he was the supreme practitioner of his age in both pursuits.

To-day most people remember Herschel as the discoverer in 1781 of the planet Uranus. The first recorded discovery of a new planet in historical times had, and indeed still has, a dramatic quality which causes the other achievements of the discoverer to be overshadowed in any popular view of his fame. And even astronomers, who look at these things in a more technical light, recognize the discovery of Uranus as the direct cause of those mathematical calculations which led to the simultaneous discovery of yet another planet, Neptune, by the French and English astronomers Leverrier and Adams.

Because of his most famous discovery he was appointed King's Astronomer to George III at the princely salary of £150 a year, and his achievements while still in



Water-colour sketch of the twenty-foot telescope

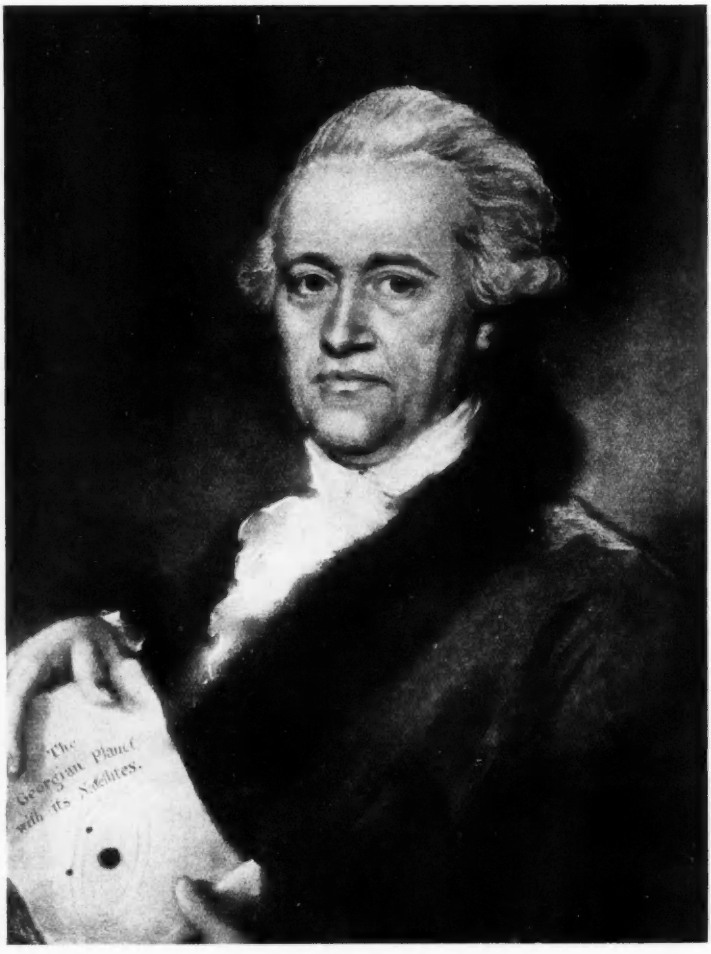
his early 40's would have made any two men of the age notable figures—one in the vital improvement of the telescope, the other in observation of the heavens.

It is a significant fact that Uranus had been seen many times before by other astronomers, but not as a planet. They had recorded its position as a star at certain dates, without realizing the nature of its movement in the heavens. Herschel was not looking for a planet—nobody in the world dreamed that there could be more than the five planets known ever since the time of the ancient Egyptians. He was engaged in an ambitious scheme to chart and observe all the stars above a certain magnitude. Among the stars of Gemini his telescope one night brought into view the disc-like appearance of Uranus. With his clear mind and superior telescope he seems to have noted immediately the unusual character of this point of light in the crowded sky. Even after repeated observations had shown him that it was not fixed he thought it must be a comet, and the startling truth, once it was realized as a possibility, had to be confirmed by the co-operative calculations of several astronomers. For the new big planet took eighty-four years to go once round the sun.

The change of profession from a comparatively flourishing musician in the West of England, to King's Astronomer was really a serious step which greatly worried the practical Caroline, who had become his assistant in sweeping the heavens as well as looking after his house. It was his fame as a telescope maker, following close upon his reputation as the discoverer of Uranus, which assured Herschel an ample income in his new establishment at Slough. He is said to have made more than eighty large

telescopes, besides many small ones. Foreign princes were among his customers, though, as Sir William Ball observed, "we have never heard that any of these illustrious personages became celebrated astronomers, but at all events, they seem to have paid Herschel handsomely for his skill. . . ."

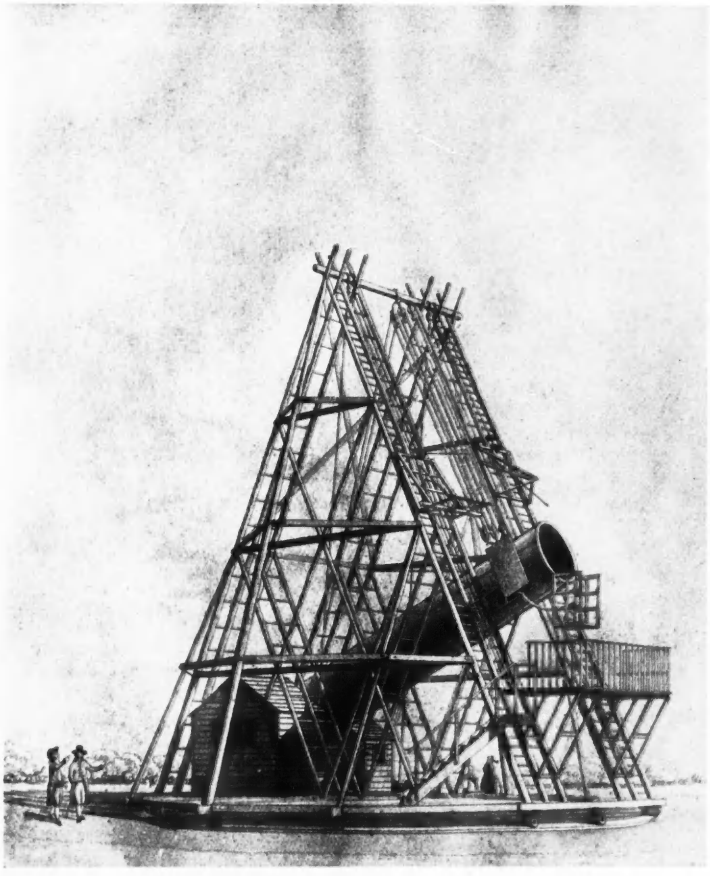
Not content with the brilliant instrument with which he had made that discovery—a 10-ft. reflector based on the Newtonian telescope—he continued his laborious construction of new instruments. We find him in 1788 devoting most of the summer to putting the finishing touches to a 20-ft. instrument, with a 19-in. speculum. At Observatory House, Slough, he made his fourth and final survey of the heavens with this excellent telescope, which was to



Sir William Herschel at the age of 56

prove more satisfactory than the 40-ft. one he subsequently made, and which is the subject of the design on the stamped miniature of the R.A.S. seal.

His sister Caroline shows us Herschel's undiminished zeal and even indifference to physical danger in pursuit of his observations. "My brother", she wrote, "began his series of sweeps when the instrument was yet in a very unfinished state, and my feelings were not very comfortable when every moment I was alarmed by a crack or fall, knowing him to be elevated fifteen feet or more on a temporary cross-beam instead of a safe gallery. The ladders had not even their braces at the bottom, and one night, in a very high wind, he had barely touched the ground before the whole apparatus came down. Some labouring men were called up to help in extricating the mirror, which was fortunately uninjured, but much work was cut out for carpenters next day."



The forty-foot telescope at Slough

Long before he died in 1822 Herschel suffered from declining health and his equable temperament was obscured at

times by melancholy, although he had the satisfaction of seeing his son John (afterwards Sir John Herschel) taking after him in the study of mathematics and astronomy. John was born in 1792 and became a Senior Wrangler. He was eventually a pioneer of meteorology. His son, Sir William James Herschel, inaugurated in India a police system of finger-print records which became the foundation of the modern scientific system used by every central police organization. Born in 1833, he died as recently as 1917 (longevity seems always to have marked the Herschel family), while his brother, Colonel John Herschel, R.E., F.R.S., F.R.A.S., who died in 1921, Sir John's third son, was Deputy-Superintendent of the great Trigonometrical Survey of India last century, and a member of the Senate of Calcutta University. The surviving holder of the baronetcy, the Rev. Sir John Charles William Herschel, is also a Fellow of the Royal Astronomical Society, and Vicar of Perranzabuloe with Perranporth, in Cornwall.

These brief notes on the famous astronomer's immediate descendants serve as reminders merely of an exceptionally interesting example of apparently inherited gifts, but we ought really to return to the great man who was born two hundred years ago on 15 November. And perhaps the most interesting way to do so is to quote from *The Herschel Chronicle* by his granddaughter, Constance A. Lubbock, the translation of the Latin epitaph on Sir William Herschel inscribed on a tablet in Upton Church, Slough.

EPITAPH

WILLIAM HERSCHEL, KNIGHT OF THE GUELPHIC ORDER,

Born at Hanover, he chose England for his country.
Amongst the most distinguished astronomers of his age

He was deservedly reckoned.

For should his lesser discoveries be passed over
he was the first to discover a planet outside the orbit of Saturn.
Aided by new contrivances which he had himself both
invented and constructed he broke through the barriers of the heavens
and piercing and searching out the remoter depths of space
he laid open to the eyes and intelligence of astronomers

the vast gyrations of double stars.

To the skill

with which he separated the rays of the sun by prismatic analysis into heat and light

and to the industry

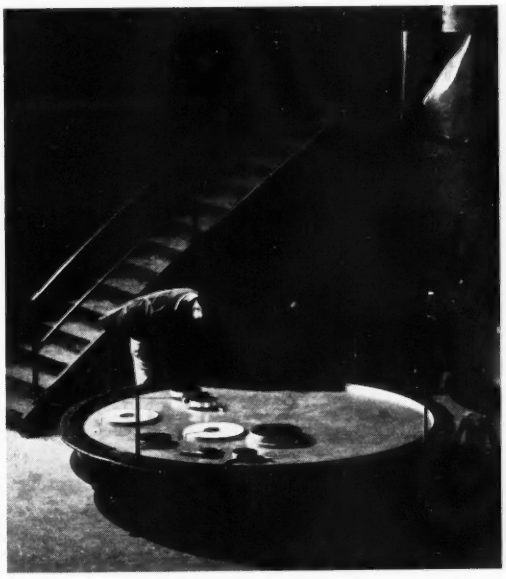
with which he investigated the nature and the position of nebulae and of the luminous apparitions beyond the limit of our system, ever with innate modesty tempering his bold conjectures, his contemporaries bear willing witness.

Many things which he taught may yet be acknowledged by posterity to be true, should astronomy be indebted for support to men of genius in future ages.

A useful blameless and amiable life distinguished not less for the successful issue of his labours than for virtue of true goodness was closed by a death lamented alike by his kindred and by all good men in the fulness of years on the 25th day of August, the year of our salvation 1822, and the 84th of his own age.

TELESCOPE MIRRORS

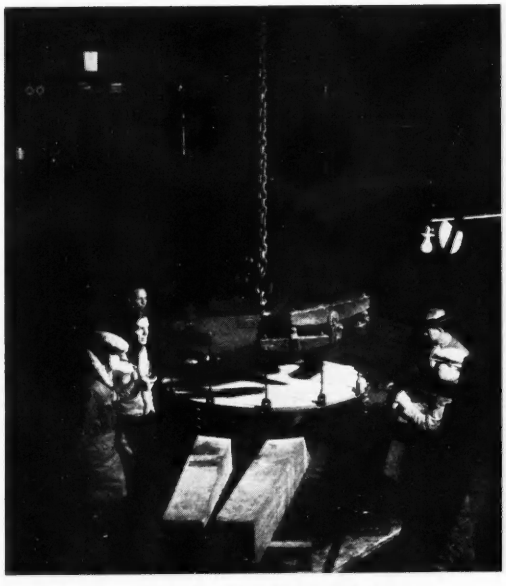
A Newly Discovered Silvering Process to be tried on the 200-inch Disc at Mt Palomar



Examining some small mirrors with the new surface

BEFORE 1935 the mirrors in astronomical telescopes all had surfaces of silver, like an ordinary looking glass. But in February of that year the astronomers of the Mount Wilson Observatory near Pasadena, California, decided to try aluminium instead. The experiment turned out so successfully, that aluminium surfaces are rapidly coming into use in leading observatories all over the world, and it is strange to think that the same metal from which a coffee pot is made is also one of the best reflectors of starlight.

The mirrors in the great telescopes of the Mount Wilson Observatory were recently removed from their cells and given the first new reflecting surface they have had since the last one was applied three years ago. This surface consists of a film of metallic aluminium only four-millionths of an inch thick. The difficult task was carried out by a crew of



Glass mirrors being moved by special apparatus

experts from both the Mount Wilson Observatory and the California Institute of Technology, where the 200-in. mirror is now being ground. The event was one of great scientific importance, for the experience gained at Mount Wilson will be of the utmost value when the 200-in. disc is aluminized for the first time.

The most important part of the aluminizing apparatus consists of a 9-ft. chamber weighing 6000 lb. that is sealed in place over the mirror. Inside this chamber are tungsten wires, on to which small pieces of aluminium are clamped. An elaborate pumping system works for eight hours to evacuate the tank, until the pressure inside is less than one-millionth that of the air pressure outside. A current is then sent through the tungsten wires until the aluminium on them evaporates over the top of the mirror. When the chamber is removed, the mirror is found to have an amazingly bright reflecting surface. One of the most remarkable features about it is that the instant it comes in contact with the air, a thin transparent coat begins to form over it which prevents the aluminium underneath from tarnishing. It is extremely durable, probably being as hard as sapphire.

But the great advantage that comes from the aluminizing process is not simply the fact that it wears better, but that it reflects the invisible ultra-violet light much better than silver. This has made it possible to photograph stars that had never been seen before with the ordinary mirrors. Thus an entirely new field of research has been thrown open to astronomers, not by spending great sums of money on larger telescopes, but simply by putting a different coat on the mirrors they have already.

R. S. RICHARDSON and GLENN C. MOORE

Adjusting the mercury gauge that indicates air pressure in the vacuum chamber used in aluminizing the mirrors

Notes of the Month

The Antiquity of Modern Man

A NOTE in a recent issue of *Nature* by J. Reid Moir draws attention to the far-reaching possibilities of Mr A. T. Marston's discovery of the "Swanscombe Man". "Thanks to the careful and scientific manner in which this discovery was treated by Mr Marston, there can remain no doubt", says this contributor, "that these human bones were indeed *in situ* in the gravel and formed an integral part of it." This is the important point, for though the gravel bed dates the Swanscombe man far back in the generally accepted history of development, the skull, according to expert opinion, is of a modern type. If man is evolved from anthropoid stock, bones as ancient as this should invariably show evidence of this ancestry. Some fossil remains do bear such evidence, but others are of modern type. Mr Moir concludes, therefore, that intelligent "beings" must have existed in Pliocene or even Upper Miocene time, though anatomists are agreed that no anthropoid ape was sufficiently evolved at such epochs to merit the term. The supposition is that man may have divided from the primitive primate stem long before the branching off of the anthropoids. If this supposition is true, then the great antiquity of the modern type of man becomes increasingly probable.

Photography and Documents

The use of photography in bibliographical and literary research is growing, and many optical-instrument makers are now constructing special apparatus. The matter was under discussion at two of the sessions of the recent International Conference for Documentation held at Oxford. Almost all big libraries now possess apparatus for the production of photostat copies of rare books and documents, and it is no exaggeration to say that literary and bibliographical researches have benefited enormously by this simple application of photography. But the miniature reproduction of documents and books on film, though it can boast many uses, is still perhaps waiting for a degree of standardization before it gets full recognition. The advantages in cheapness of material and in saving of space are not to be gainsaid, however, and it is only a matter of time before the system comes into the widest general use. Negative copies are made, on standard 35 mm. film, page by page, of the material. One of the difficulties, now being overcome, is the loss of sharpness due to the grain of silver emulsions. Has it ever been suggested that an adaptation of the grainless process, whereby a dye image is substituted for a silver image, might lead to still greater accuracy? This process, which is the basis of some of the best modern colour-work, does not involve any loss of speed in the

material, and presumably the finished stock, since it consists of a pure-dyed gelatine image, would be more permanent.

Various ways of reading from these minute but accurate records are available, from the simple magnifying viewer, to beautifully designed projection apparatus. Anyone who has had to work with newspaper files (to take one instance) would need little persuasion to see the advantages of the miniature film system. The researcher sits before a white desk upon which a complete page of the journal is projected, a touch of a lever moves the film on to the next page, or back or forward to any needed page. Nothing but an exact *shadow* lies on the worker's table and he can, if he wishes, take home a century of newspapers in neat, light coils of celluloid. An exhibition of the most up-to-date apparatus, material, and methods available has recently been arranged at the Science Museum, South Kensington, by Colonel E. E. B. Mackintosh.

Natural Fruit-juices

In an article in the *Bulletin* of the Imperial Institute, Dr H. A. Tempany, Assistant Agricultural Adviser to the Colonial Office, calls attention to the possibilities of a trade in natural fruit juices in the United Kingdom.

He writes that there is an appreciable trade in citrus squashes and cordials, but that these are juices which have undergone some form of manufacturing or preservative treatment. In the United States of America, and to a lesser extent in certain European countries, there is a considerable trade in fruit juices which are preserved in such a way as to retain unaltered the characteristics of a fresh fruit juice.

In the U.S.A. the medical profession has advocated the consumption of fresh fruit juice as part of a campaign for health, on account of the vitamin contents, and in consequence much attention has been devoted to the preservation of citrus juices by methods which will retain in unaltered form the vitamin contents.

This campaign has found no parallel in Britain so far. It is thought that if similar propaganda were undertaken by the medical profession in this country it would greatly stimulate a trade in fresh citrus fruit juices, and might be the means of extending considerably the consumption of citrus fruit or its equivalent in juice. Orange juices are imported from the United States, Spain, South Africa and Jamaica. Lemon juices come from Italy, Sicily and the U.S.A. and lime juices from the Gold Coast and the West Indies.

There seems little doubt that the existing demand by the trade in this country is for raw juices rather than for concentrated juices. This is doubtless because the unconcentrated juices suit methods of manufacture at present. If, however, by freezing or other methods of concentration the trade could obtain juice offering technical or commercial advantages over the present raw juice they would doubtless resort to this material. That there is increasing interest in concentrated juices is shown by the fact that small quantities of juices concentrated by the vacuum process are already coming in.

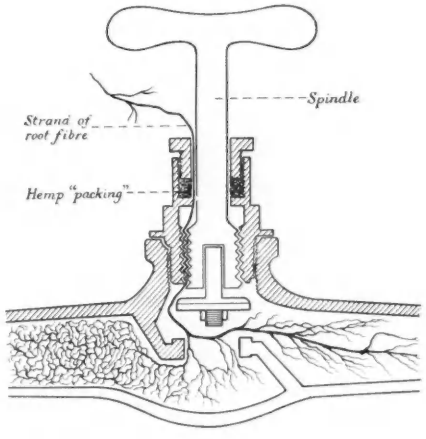
Crops without Soil?

A book recently published in America, *The Soil-less Growth of Plants* (by Ellis and Swaney), describes what may some day be a profitable method of horticulture. Culture solutions either in liquid form or combined with an inert solid (such as sand) have been used in laboratory experiments for many years. Ideally this method should give very exact control of the development of the plant, and recent experiments to adapt it to commercial purposes have not been entirely unsuccessful, though much remains to be discovered both in the necessary constitution of the culture solutions and in the technique of using them. It is not impossible, however, that the flower and fruit growers of the future may succeed in raising more and finer greenhouse crops by supplying the carefully calculated chemical necessities of growth direct to the plants.

Letters from Readers

Root growth inside a Tap

The following interesting discovery was made at a house at Stockton Heath: complaint of reduction in the flow of water into the sink and bath and from ball-taps led to investigation. When all taps were closed, and static pressure taken, the supply was found to be normal for the district. This indicated that the cause was obstruction rather than leakage. The service pipe from the indoor stop tap to the water in the main road was traced by means of a "wireless" locator. Other tests suggested the presence of another stop tap in the garden, and it was decided to dig this out and examine it. The examination of the tap revealed this interesting botanical fact: the reduction in flow was due to a fibrous root-growth inside the stop tap and connecting pipes. On the inlet side of the stop tap the fibrous growth was tightly packed, and was about two or three inches long. On the outlet side, strands of root up to six inches in length were pulled out. As the fibre was much decomposed, it was impossible to determine the species, but a report from Kew suggests that it belongs definitely either to a shrub or tree, and, as a beech tree grows nearby, the possibility



of its belonging to this is assumed. Close scrutiny revealed that a single fine strand had penetrated into and through the "packing" gland. The clearance between the spindle and the gland would probably be about one hundredth part of an inch and the packing material (hemp) would be compressed to withstand a minimum pressure of 60 lb. per square inch.

F. HUGHES

Stockton Heath

Telepathy

I have read the article in the September number of *Discovery*, "Wonders of the Dreaming Mind. II. Telepathy", by R. L. Mégroz. At the end of the article the author writes: "...it is up to our sceptical psychologists to state why they cannot accept the evidence already accumulated by scientific men for extra-sensory perception, instead of relying on ill-conceived, endlessly repeated, routine tests in card-reading."

I will tell him why: Because psychologists are, as a rule, unbiased and look at the alleged phenomenon objectively and, being experimental psychologists, have received the proper training for conducting a psychological experiment. They see that the scientific men, to whom the author refers, however eminent they may be in their own department of science, have not the faintest notion of the requirements and safeguards to be taken in a psychological experiment. Further, the internal evidence of their reports frequently shows that they are biased, prone to mysticism and bent upon "proving" their preconceived ideas.

In 1907 I was doing research work in the Psychological Department of University College, London, which was then under the direction of Prof. Wm. MacDougall. He prevailed upon me to join the Society for Psychical Research and the first and, I believe, the only meeting I attended was the one in which Prof. Barrett read the paper on the experiments of the Misses Miles and Ramsden referred to in Mr Mégroz' article. I remember how astounded I was that such stuff should be put forward as a serious psychological experiment. When, however, at the end Sir Oliver Lodge, who was in the chair, got up and said that if anyone was present who had had any doubts about the existence of telepathy he would certainly be now convinced, I wondered whether I had been asleep, or woolgathering. For this reason as well as for the announcement that the paper was so important that it would be published in the *Proceedings* of the Society, I preferred to abstain from taking part in the ensuing discussion. I communicated my opinion to Prof. MacDougall and, after reading the paper on its publication, I wrote to the Secretary of the Society for Psychical Research. I pointed out that from a psychological point of view the experiments of the two ladies were valueless as to the evidence in favour of telepathy. For me they were, however, quite informative as to the character and personality of the experimenters as well as of Prof. Barrett and Sir Oliver Lodge. I mentioned also that numerous experiments had been done in psychological laboratories and that they had been invariably negative. I admitted that the absence of telepathy between some persons does not prove the non-existence of the alleged phenomenon which might possibly exist between some other persons. I said that I should, therefore, be much obliged if the Secretary would prevail upon the two ladies to consent to a further investigation under proper scientific experimental conditions or put me into communication with them to discuss the matter with them. I would induce the best known trained experimental psychologists of the time to assist in the investigation.

In due course I received an answer which simply stated that the Secretary was pleased to note that I was interested in telepathy, advised me to conduct experiments of my own and communicate the results to the Society. I then formed my own opinion on the purpose of the Society for Psychical Research and resigned from membership.

Since then I have made several attempts to induce claimants to telepathy and clairvoyance to submit to investigations under experimental conditions but have never been successful.

A. WOHLGEMUTH
D.Sc. (Lond.)

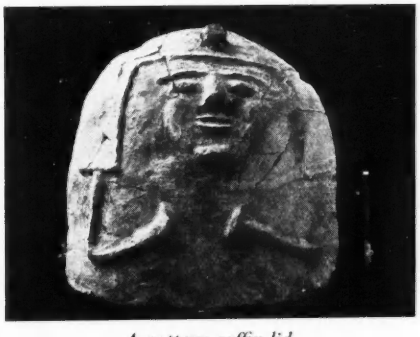
Shortlands, Kent

Excavations at Lachish, 1937–1938

By E. N. Fallaize

(An exhibition of antiquities from the excavations was held at the Wellcome Research Institution, Euston Road, London, during the summer)

NOTWITHSTANDING the great blow suffered by the members of the Wellcome-Marston Archaeological Research Expedition to the Near East through the murder of their leader, Mr J. L. Starkey, by Arabs on 10 January 1938, the work of excavation at Tell Duweir, the ancient Lachish, in Palestine, was carried on without interruption, as he himself would have wished. It was, however, only through Mr Starkey's meticulous care in working out every detail of the organization that the work of the season had not to be brought to a premature close.



A pottery coffin lid

The earliest operations of the members of the expedition on arriving at the camp in the autumn of 1937 were directed towards solving the problem of the great shaft, 80 ft. by 70 ft. by 80 ft. deep, at the south-east corner of the Tell, of which three sides had been examined by means of tunnelling at the base in the previous season. A fourth tunnel was driven along the west side to reveal the north-west corner, and one to the centre. The uneven state of the floor showed that this great work of the seventh century B.C. had never been completed; but no indication was found of its purpose. There was no sign that it had been intended to be the exit of a subterranean passage from the city, as had been thought, and it is possible that it was to be a great reservoir, such as that at Gezer.

In the course of this year's work investigation of the Bronze Age temple was completed, which, owing to interruption by flooding, has taken five years. Excavations were carried down to bed rock. The most important result is a redating, both of the building of the original temple and of the reconstruction. Outside the walls of the original temple were a number of rubbish pits, which contained quantities of interesting pottery. Among this was a large polychrome jar with beautifully painted metopes, showing in panels realistic representations of ibex, ibis, and tunny-fish. Mr W. A. Heurtley, of the Palestine Department of Antiquities, places this poly-

Polychrome vase

chrome ware as a class at about 1550 B.C. This, together with carinated bowls of Hyksos type, would place the foundation of the early temple at a considerably earlier date than had hitherto been supposed. The second reconstructed temple is now shown by a small faience plaque of Amenhotep III, found on top of one of the walls and almost immediately under the altar of the second temple, to come definitely within the reign of that monarch.

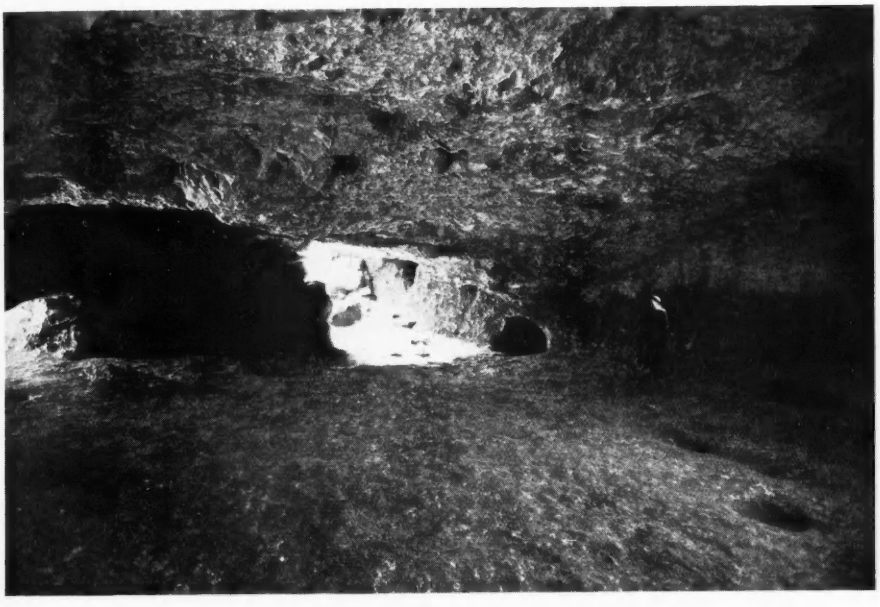
The discovery, in excavating down to bed rock, of quantities of cinders and charcoal provides the first evidence of the burning of the Middle Bronze Age city.

Much interesting material came from the cemetery on the north-east side of the Tell, and from cave burials and cave dwellings belonging to the Early Bronze Age and dating from about 2500 B.C. A most striking find, however, was made not in the cemetery, but in three tombs of the nineteenth dynasty, which were encountered in digging down to bed rock to widen a road near the camp. In these were the first examples of pottery sarcophagi to be found at Lachish. They were in the form of "slipper" coffins with lids moulded to represent the features of the deceased. The third coffin is unique in bearing an inscription in hieroglyph. On the two sides Isis and Nephthys are shown elaborately mourning, while in the centre is the inscription in red on a white slip. The inscription betrays an unskilled scribe and shows, it is thought, the influence of hieratic. It has not yet been fully interpreted, but is evidently not in an Egyptian formula.

In the cemetery to the north-east of the Tell were found a number of undisturbed burials—an unusual feature at Lachish—at

considerable depth, some as much as 30 ft. down. One eighth-century tomb, containing the burial of one man and one woman, with rather poor grave furniture which included a perfume flask from Cyprus, directed attention to a remarkable feature afterwards found to extend over a considerable area. It is a soot-like surface deposit on earth, rocks, stones, etc. Subsequent analysis has shown this to be of organic origin, but no explanation as to its source is as yet forthcoming.

In this area traces of the existence of a suburb of the Late Bronze Age were found. This is the third place in which evidence has been found of the overflow of population outside the city in the prosperous period of the nineteenth dynasty.



A Potter's Workshop of the Late Bronze Age, found at Lachish

In the Early Bronze Age caves dating from about 2500 B.C. a number of contracted burials were discovered, as well as evidence of occupation at this and other periods. Of these caves the finest was of considerable size and was largely of artificial origin. It had been enlarged in various directions at different times and was of quite irregular outline. A rough pillar of stone had been left in the centre to support the roof. The enlargements had been made with polished flint tools, of which the regular marks could be clearly discerned. In one cave a new entrance had been made in the Iron Age and the difference in the method of working was plainly visible.

Fragments, lips, handles and spouts of large jars were found in quantities and suggested communal beer-making and beer-drinking. One of the most interesting

assemblages of exhibits was derived from a Late Bronze Age potter's workshop. In a cave, which in Judaean times had been used as a stable, the lower levels contained a quantity of unfired pottery, while in a pit at the side was a pair of stones with pivots, which may have served as fly-wheels for turning the potter's table, as a fly-wheel is turned by the foot in Palestine to-day in order to leave the potter's hands free for his work. In a cave nearby was the potter's stock-in-trade. With the unfired pottery were found red and yellow ochre for painting the vessels, bowls for mixing the paint, and pebbles polished on one side, as well as shells, such as are still used by Palestinian potters, for burnishing the pots, while a shaped and pointed bone may have been used for drawing incised ornament. Although lumps of slag were present, the furnace for firing the pots has yet to be found.

Investigation was pursued on the upper levels of the mound, and a building, evidently of very considerable importance, belonging to the Ramesside period, possibly a palace, was brought to light. It was now late in the season and it was therefore thought inadvisable to start the examination of a structure of such importance with so little opportunity for adequate investigation, and it was accordingly covered in again.

Further examination of structures in the neighbourhood of the great city gate revealed evidence of the intensity of the fire in the final siege of the Jewish city. The brick walls were burnt red right through. It was also found that anyone entering the city had to pass through entrance fortifications for a distance of at least forty yards.

It was left, however, for the final stages of the work of the season to produce what was perhaps the most significant find of the season's excavation. After the first sack of the Jewish city in 597 B.C. the palace was not rebuilt, and a number of poor and insignificant houses were erected on its ruins in the reign of Zedekiah. In clearing these, steps up to the palace were uncovered. At the foot of these steps was a stone with circular depressions which may have been meant for offerings of grain. Underneath the steps was an earlier staircase, of which one step was uncovered. Here schoolboy sketches of a lion and a number of concentric circles were found, and on the last day before the expedition left camp, the first four letters in order of the alphabet of the Judaeo-Phoenician script. This is the earliest concrete evidence of the order of the letters of the alphabet to be found in Palestine and the first evidence of the study of this alphabet as a matter of scholarship.

Think of your Friends: *A copy of* Discovery *every month for a year will come as a pleasant and enduring gift to the right kind of person. A special offer appears on p. xii of the advertisement section in this number; if you will fill in the form and send it to the Manager he will be pleased to post the Journal for you to any address.*

Superstition is Returning

By Stanley Brogden

OF social phenomena to be observed in this decade none is more astounding than that of the revival of superstition. As though weary of the enthusiastic cynicism that gripped the young minds of the 1920's, old and young of the 1930's are rapidly and in many cases unconsciously becoming hagridden with superstition.

Admittedly it cannot be said to-day as it was by the essayist that "I have known the shooting of a star spoil a night's rest; and have seen a man in love grow pale, and lose his appetite, upon the plucking of a merrythought. The screech-owl at night has alarmed a family more than a band of robbers; nay, the voice of a cricket hath struck more terror than the roaring of a lion." Yet it is difficult to find any previous period in British history in which the astrologer has enjoyed such a tremendous hearing.

Of the eight morning newspapers published in London, four contain daily horoscopes. The combined circulation afforded by these four newspapers is between six and seven million. Of provincial newspapers, about 50% publish daily or weekly "readings" to raise the astrologer's daily circulation to the immense figure of ten million. Adding to this total the circulations of weekly periodicals which afford similar facilities, it is computed that every man, woman and child in the United Kingdom could be provided with a weekly horoscope from the press.

This is a development of short history. Eight years ago the astrological public from the press point of view was almost nil. The brilliant journalistic attainments of a man who was mathematical computer to the late Count Louis Hamon, "Cheiro", and the publicity afforded him by an energetic national newspaper during circulation wars commenced the return of superstition. As in the case of jazz and certain theatrical religions, modern astrology overflowed from the United States. The grip of the astrologer upon the American mind cannot be grasped by those who have not studied it at first hand. To millions of Americans, hard-bitten business men as well as neglected housewives, the influence of the stars is a living thing. More than a dozen magazines devoted to astrology have gained large circulations. Not one wireless listener in the United States need pass a day without turning on an astrological forecast. Across the Canadian border the Government grew so apprehensive of the effect of superstitious influence upon Canadian mentality that a Bill was passed banning astrologers from Canadian wireless stations and restricting their contributions to the press. In fact, I am told by international astrologers, no lecturer will accept a tour in Canada.

I believe that few people here in this country realize the hold that the newspaper astrologer has upon the public. When a certain national newspaper's astrologer fell ill a year ago and one issue of the paper appeared without his forecast, the office routine was literally disrupted by fifty thousand telegrams, telephone calls, letters and even personal calls *within twenty-four hours*. An "Indian" magician of the stars who broadcasts regular weekly programmes from Continental commercial wireless stations charges a fee of threepence per horoscope. Each of his horoscopes contains some twenty to forty sheets of matter. Postage at three halfpence leaves the same sum for the gentleman concerned. He pays some five thousand pounds a year for wireless programmes and advertises extensively in the Indian press. The number of his patrons must reach astronomical figures.

A prominent journalist recently told me of his astonishment at the fear complex which the press astrologer has nurtured. His astonishment is well founded. Thousands of otherwise mentally balanced British men and women to-day refer to their morning horoscope to assess the day's influences. Within the past month I have encountered twenty-three cases in which quite capable and influential business men have postponed transactions until the stars are propitious. For it must be understood, however unpalatable, that the star cult is *not* a feminine idiosyncrasy. It is a fact that women will admit an interest in astrology more readily than men. Male superstition is difficult to assess. The male reader of the daily forecast is generally ashamed of the fact—not merely shy, but genuinely ashamed. It is the most ludicrous and appalling secret vice in history. Your primitive accepts his superstition as a matter of course; it is part of living. He cannot understand the incredulity of the European. Speaking pathologically, I suppose the savage's superstition is a structure superimposed on a basic belief modified to local conditions through centuries. White credulity in the influence of unscientific and irreligious phenomena is a mental drug—sedative or excitative—mentally prepared from the single seed of a perhaps subconscious racial memory that civilization has not yet eradicated.

At the back of the minds of millions there is the haunting notion that there *might* be something in the star-cult. Where doubt is present, belief is sprouting. An aspect of the hardened business man's belief is self-explanatory. Of the twenty-three cases mentioned all the parties concerned were of the Americanized type who literally live, eat and drink business to the exclusion of all other interests but those of politics and sport.

The disciples of the astrologer may be classified. Almost exclusively the cult is found among working-class wives, the great mass of young women office workers, young wives of the middle class, neurotic elderly ladies of the society classes, high-pressure business men and a few young men throughout the professions adopted by the secondary schoolboy. I have yet to find a woman holding a responsible business position who credits astrology. With the young and married women the

belief is not dangerous, merely affording the believer a hobby. The frightening and dangerous aspect of the cult is its growing hold upon young men of the middle classes through sheer habit. Three-quarters of the periodicals and newspapers read by this class contain horoscopes in every issue. The man is not human who refuses to read the forecast. Constant repetition has its effect. A prominent bishop once said that nothing man reads is entirely forgotten or without influence. The mind forgets nothing.

I have attempted to discuss the problem with these young men. When I have managed to pierce their shyness on the point—not one in twenty admitted his credulity—I have pointed out the absurdity of a science which admits of innumerable explanations of identical phenomena. For instance, the day's influences forecast on the same day by national newspapers said:

URANUS. . . January 20–February 18.

(*a*) Heart interests—Cupid will find you to-day. You will not have far to go in search of happiness. Finance—Your purse will be a full one.

(*b*) Give a thought to intimate friends. Try to lighten their burden, plan a party or bring home a surprise gift. Clear up arrears of correspondence this evening.

(*c*) Not much to rejoice about, but nothing to worry about in the long run. Don't count upon people keeping appointments or doing anything to schedule.

All of which is a fascinating mess of generalities. For SUN people who were born in July–August, it was alleged that: (*a*) Petty irritations may depress you to-day. (*b*) Accept domestic responsibilities gladly. (*c*) Your correspondence will bring a smile to your lips and joy to your heart.

Was there ever such evasion, such conflict? At least a workman might attempt to produce goods worthy of his not too-modest hire. Upon my pointing out this conflict of interpretation to him, an astrologer acquaintance replied calmly that all forecasts should be identical.

My friend pointed out that all astrological forecasts are based upon movements of the stars calculated in tabular form by scientific astronomers and published for the use of astrologers. All forecasters use the same textbook. What then was the explanation of the errors? He claimed that whereas some members of his profession work from a rule of thumb, others have a mathematical chart of the relation of planetary movements upon human life. He, on the other hand, depended upon the charts merely for his astronomical information: from that he worked by intuition or what might be termed psychic sensitivity. He stated quite firmly that his method was the one honest way. Astrologers must be psychic. Otherwise, any person who made a short study of astrology from certain textbooks and who could type the dialect required of press astrologers could set up a flourishing journalistic practice. In fact, he admitted, that was the explanation of such diversity.

Knowing my acquaintance, I have no doubt that he is genuine in his faith in his "art". He lives for it, not merely by it. Nor do I doubt the honour of many such men and women in this country.

Yet I believe that they, above all people, should expose the modern ramp. The Society now existing should expose these charlatans at their next annual conference, not merely by condemnation from a platform but by public appeal.

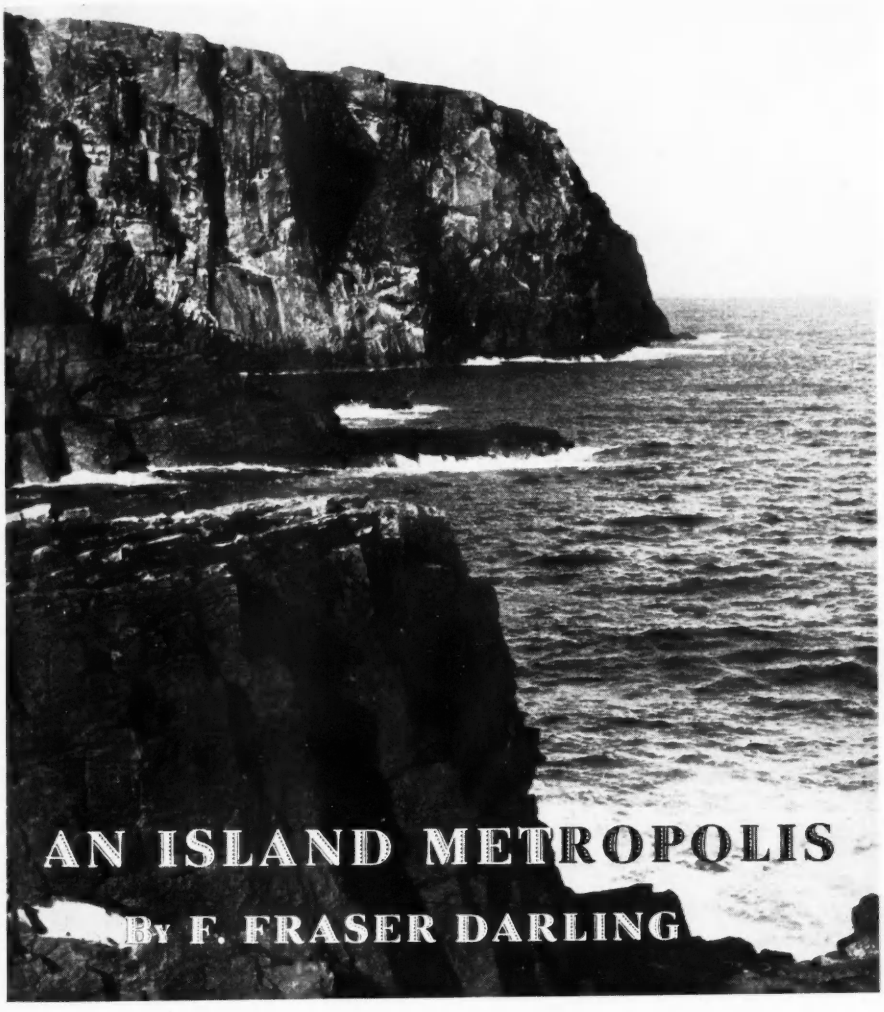
The public would resent the culprits' duplicity. Young men to whom I pointed out the diversity of opinion in the press forecasts were surprised and resentful. They had been cheated and they were disgusted. In every case, this revelation cured. The trouble is that most of us read one morning newspaper. A man may buy his shoes in four different shops within twelve months, but his newspaper and his cigarettes are identical day after day. Interested readers do not notice the conflict between forecasts because they see the same person's outpourings each day.

It may be thought that I have taken all this too seriously. I believe that it cannot be taken too seriously. The dangerous side of the modern astrological cult is its social effect. A bad forecast of the day's influences does affect the energies of thousands of people. This may be subconscious or through determination, but a brief investigation would assure any reader that this effect is noticeable. I challenge any person who is in a position to test this to prove me wrong. Select a group of people in any city office, club or hotel and observe closely the work of each member of the group. The effect of the press astrologer upon life can be assessed within a week.

Primarily, the cult of astrology is fatalistic. It is inculcating a feeling of fatalism among people whose racial intelligence and culture are opposed to any predestination. Fatalism is essentially opposed to the temperament of the Northern European peoples. It has been bred purely among the enervated agnostics of the East. That astrology has been condemned in no uncertain terms by the Roman Catholic clergy and press and by certain leaders of other organizations proves the apprehension felt in religious circles.

This apprehension must be stated at large. The Canadian authorities have acted decisively and without fear of being dubbed alarmist. Similar action should be taken in this country. I have no doubt that it is only a matter of time before such action will be taken.

DR F. FRASER DARLING'S *work as writer and photographer now needs no introduction to readers of* Discovery. *Dr Darling has already spent part of the summer on the remote island of North Rona, studying the Atlantic seals there. By reason of the recent Crisis he was fetched back to Scotland unexpectedly, and found time to send us the following article. These are the first of his photographs taken on North Rona. He has now returned to the island until Christmas.* ——————→



AN ISLAND METROPOLIS

By F. FRASER DARLING

NORTH RONA has often been called Britain's loneliest island, because it is uninhabited, farther from land than St Kilda, and almost always a very difficult place upon which to land. Rona is also less than a third of the size of St Kilda and has never been visited as frequently as that much be-written island.

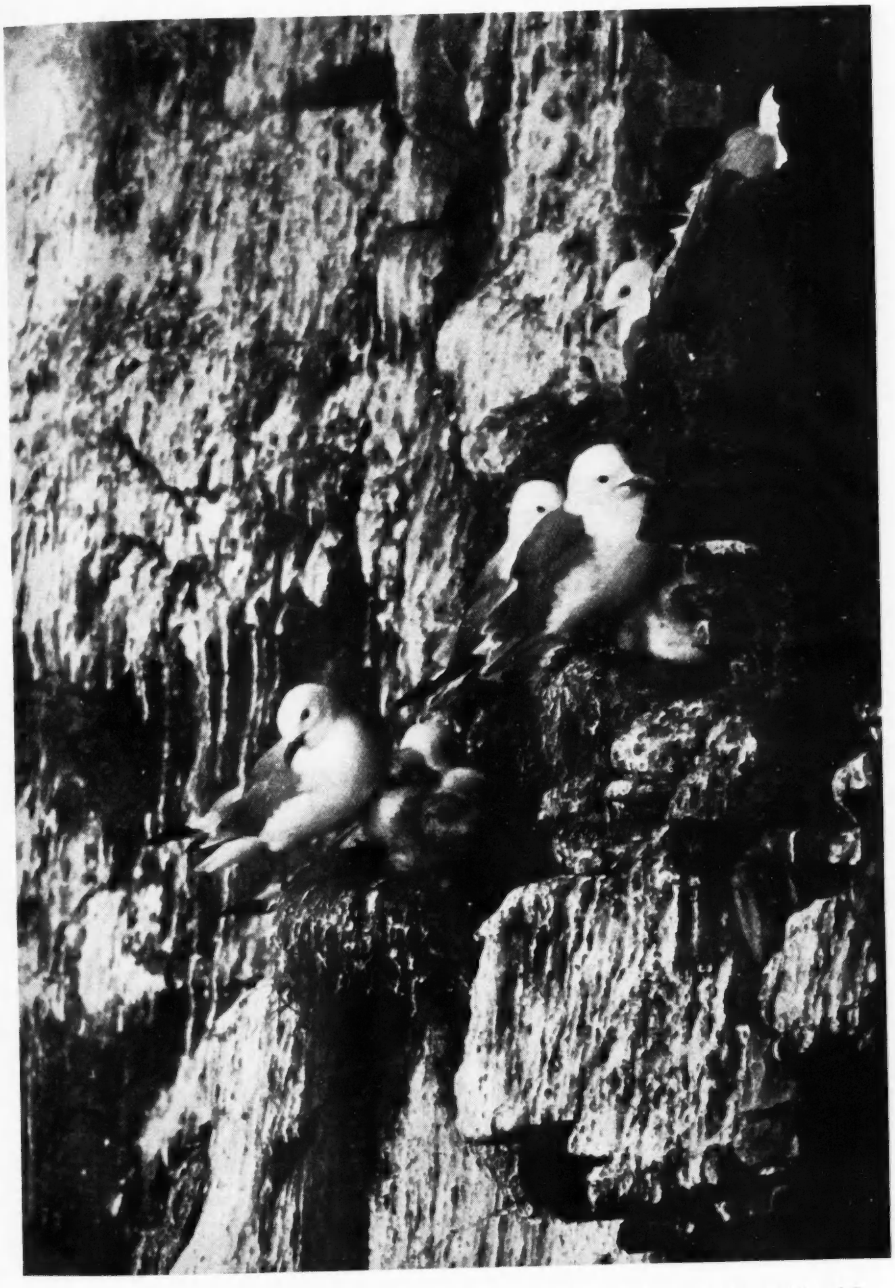
North Rona lies open to every wind that blows, nearly fifty miles north of a line drawn from the Butt of Lewis to Cape Wrath. Whether you go to America or to the North Pole from Rona you will meet no land in between, and such an immensity

Atlantic Grey Seals playing in the immense surf on the western coasts of North Rona

of open ocean makes for terrific seas against the gneiss cliffs of this little island. The northern peninsula of Rona is called Fianuis, meaning witness or looking forth. It reaches a height of about seventy feet and when you are threading a difficult path over the bare surface of rock on a summer's day, it is hard to believe that the sea itself, not a mere pother of spray, can rise on to this place. But it does so in a high north or north-westerly gale, and in some of the gullies are great boulders weighing a ton or two, showing recent bruises themselves and marks on the black cliffs where they have been rolled about by the sea as if they were pebbles. All this becomes easier to understand when you are on Fianuis in a mere fifty-miles-an-hour gale.

North Rona is lonely from the human standpoint only. For *Ron Mor*, the Atlantic Grey Seal, and for many species of birds it is a metropolis, a very hub of the universe. In fact Rona can show a combination of animal life which no other place in Britain, nor even in the world, can offer. It is the great headquarters of the grey seal and from July to September these animals are immigrating—at first a bare two hundred, and then week by week the number grows to two thousand, all amusing themselves about the island cliffs until the beginning of the breeding season. I say amusing themselves because I think that is the right word. They are fat and do not bother to feed much, and are very playful. There is often a swell and surf of tremendous force against the cliffs of Rona even when the weather is relatively calm, and the seals romp in it like children in a hayfield. It is a fine experience to lie on the cliffs of Fianuis and watch the sleek heads come joyfully from the white turmoil of surf.

The main lump of Rona is a hill of green grass bounded by cliffs, which are three hundred feet sheer in some places, and it is here that the island teems afresh with life. The vast concourse of sea-birds is beyond counting, but there are certain indications of numbers. For example, I tried to arrive at the percentage of bridled



Kittiwake gulls and chicks on their nests on the sheer cliffs of Rona

A pair of guillemots. The bird on the right is "bridled" with a monocle-like ring round its eye

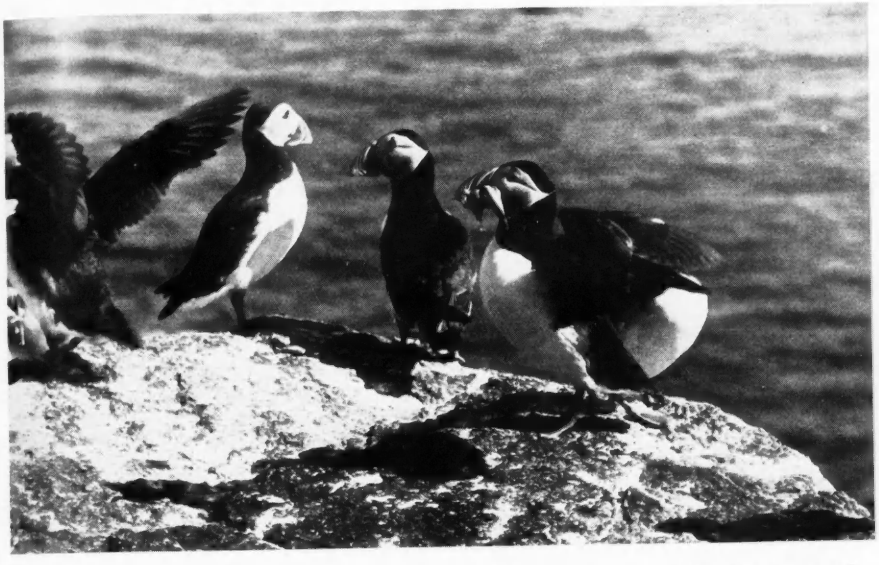
or ringed guillemots present on Rona. I counted only those on ledges to which I could get near enough to see the head of every bird clearly through my binoculars. I counted something over 3000 birds in all, of which 13·0% were bridled, and I reckoned those few ledges of birds represented about an eighth of the total number of guillemots on Rona.

Razorbills do not mass in such close groups as guillemots and they tend to occupy higher positions on the cliffs. They were much fewer in number, probably not more than 750 or 1000 pairs in all. But Rona seethes with puffins. If I am somewhere near correct in estimating a guillemot population of 25,000 birds, it is as nothing to the number of puffins, which are now compelled to make burrows well inland because the cliff-tops are fully occupied.

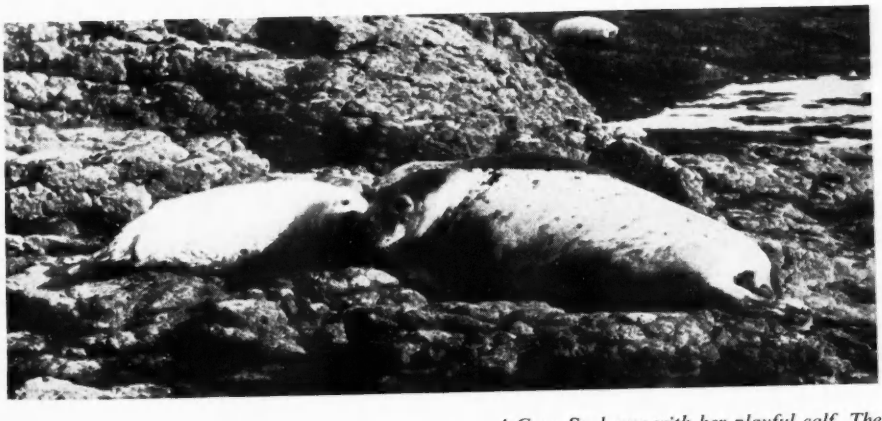
I have a soft spot for the puffin and that more particularly since I went to Rona. They were among our nearest neighbours during the summer and we could watch the mingled solemnity and ridiculousness of their behaviour from the window of our hut. Their calm dark eyes seem to show a serene philosophy. But I think the puffin has more beak than brain and he lives to be the meat of other birds. The peregrine falcon flies along the cliffs of Rona sounding her harsh cry. The little puffins would do well to stay where they are, but no, fright sends them flying out from the cliff. The peregrine takes her toll.

The puffin population of Rona is interesting in its relation to that sinister predatory bird the great black-backed gull. A flock of about 500 pairs comes to Rona to breed because of the ready food supply found in the puffins. The big gulls stand above the puffin burrows in the early morning and at about six or seven o'clock in the evening. The puffins emerge to stand around for a few seconds before flying out on those seemingly pointless little circular flights of a minute's duration. The gulls pounce, sometimes two on one puffin, and then that unfortunate bird may get pulled in two.

Suppose there are a thousand black-backs on Rona and each takes a puffin every

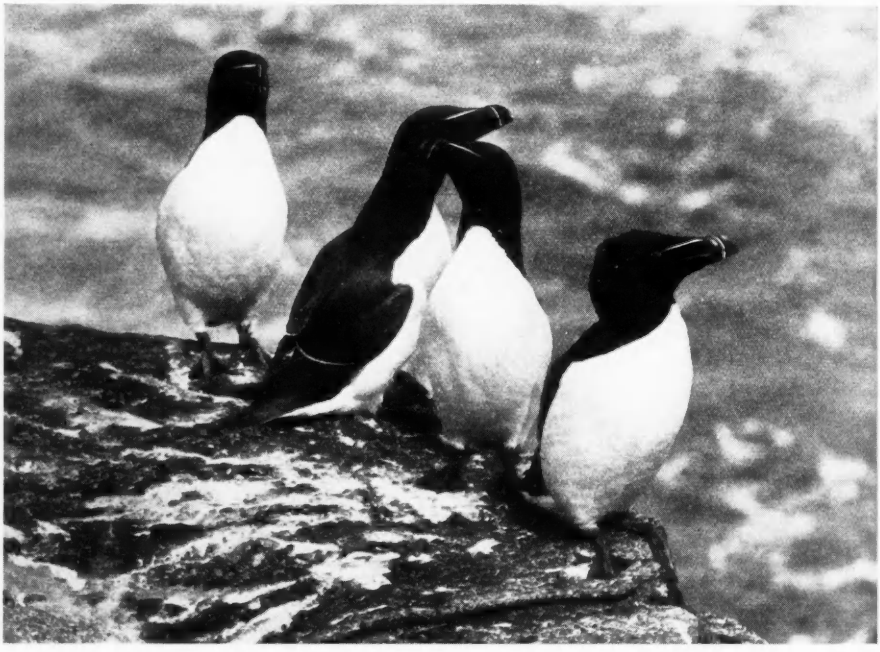


Puffins on the edge of the cliff. One of them is holding young saithe in its beak. These little fish form the birds' main food supply



A Grey Seal cow with her playful calf. The calf is about ten days old and has not yet lost its coat of long hair

four days—a very conservative estimate—that would mean 250 puffins a day, and the breeding season lasts, say, ten weeks. The predatory toll on the puffin population must be between 15,000 and 20,000 birds. And yet they appear to be just as many at the end of the time as there were at the beginning. The flock of black-backs disappear almost immediately after the puffins leave the cliffs and go to sea again. Each pair of puffins rears only one chick a year, so to maintain the population and serve as a food supply for other birds as well, it seems likely that the puffin's possible life is a long one.



Razorbills. They have small black eyes which the camera finds it difficult to show

The kittiwake gulls are as numerous as the guillemots on Rona and their little platform nests of seaweed and grass are stuck on what look untenable faces of rock. One would wonder if there was room for all these birds on the cliffs of a three-hundred-acre island, but those I have mentioned by no means exhaust the catalogue. There are two or three hundred pairs of Arctic terns, six hundred pairs of fulmar petrels, a few black guillemots, a thousand shags and an unknown but considerable population of storm petrels.

Most exciting of all is the colony of Leach's fork-tailed petrels which, though circum-polar in distribution, are found in only three places in Britain—St Kilda, the Flannan Isles and North Rona. They are exciting because of the communal

aerial dance in which they indulge at night-time. The birds fly hither and thither in the most erratic manner between midnight and two o'clock in the morning. Hundreds of birds are in the air above the fairly small area of the nesting burrows. Some are crying in a note like a staccato laugh; others in the burrows call in a sweet-sounding, upward trill. Birds collide in the air, they brush your face and hands, and the summer night is full of the sound of them. It is an amazing experience which few people will ever enjoy. The fork-tailed petrels are silent and hidden in the daytime and the casual observer would not know the colony existed.

We are here on Rona to study the seals, and their breeding immigration keeps us busy and interested. But it must be admitted we had rather a feeling of anti-climax when all the thousands of auks and kittiwakes left the island quite suddenly in August. The human mind partakes of some of their excitement and there is a sense of loss when they go. We look forward to the last week of October when the wild geese will come in from the north.

Nutrition and Health

III. Minerals and Vitamins

By C. H. March

NO matter how carefully we adjust our diets so that we get the right amount of protein, fat and carbohydrate, we should die if we did not have sufficient minerals and vitamins.

Minerals

We need minute traces of a very large number of minerals, but most of them are required in such very small amounts that we are certain to get them in whatever food we eat. There are three minerals, however, which we require in fairly large amounts. Two of these, calcium and phosphorus, make up the bulk of our bones and teeth. We excrete a certain amount of these every day, and the loss must be replaced in our food. Calcium and phosphorus are particularly necessary to the mother expecting a child and to the child itself while it is growing. The bones can only come from the calcium and phosphorus in the food, and if there is a deficiency of these necessary minerals then there is stunted growth and the teeth form imperfectly. There is, too, the likelihood that rickets will develop if the deficiency is sufficiently acute.

The third essential mineral is iron. Iron is most important to the body because from it the red pigment of the blood, the haemoglobin, as it is called, is formed. It

is this red pigment which is responsible for carrying oxygen from the lungs to all parts of the body. If there is not enough iron in food, the cheeks lose their colour and the skin becomes pale.

These important minerals may be found in the following foods:

Calcium. Cheese, milk, whole wheat, almonds, beans, cabbage, cauliflower, cocoa, eggs, lentils and watercress.

Phosphorus. Cheese, milk, eggs, almonds, beans, cocoa, dried figs, meat extracts, oatmeal, peanuts, brown rice and wheat germ.

Iron. Beans, cheese, currants, eggs, whole wheat, olives, peanuts, oysters, dried peas, spinach and turnip tops.

Altogether there are about 7 lb. of mineral matter in the body, of which 5½ lb. are in the bones.

Vitamins

These are ordinary chemical substances but are required in such minute amounts that the necessity of their presence in the diet was unsuspected for many years. After feeding his experimental animals on food substances which up to that time were regarded as being all that an animal needed, Sir Frederick Gowland Hopkins found, in 1911, that such a diet was incapable of supporting life. The professor stated as a result of these experiments that there must be some other substances essential for life about which we knew nothing—these substances he called "accessory food factors". They were later called vitamins by Dr Casimir Funk of London.

There are two vitamins called fat-soluble vitamins; they are known by the letters A and D, and they occur in fats like cod-liver oil, halibut-liver oil, and also in beef and fowl liver, in egg yolk, in butter and in milk.

Vitamin A is a colourless material but it is closely related chemically to the yellow colouring substances we find in carrots, pumpkins, mangoes, yellow peaches and so on. These yellow substances are called carotene pigments owing to their presence in the carrot. It is an interesting thing that vitamin A can be dispensed with in the diet provided that enough foods containing these yellow pigments are eaten.

If enough vitamin A or yellow carotene pigment is not included in the diet, an eye disease known medically as Xerophthalmia may develop. The word comes from the Greek "Xeros" meaning a drying up, so that Xerophthalmia means a sort of drying or hardening of the membranes of the eye. The skin will also become dry and scaly and membranes throughout the body will suffer the same fate. This disease, according to Dr L. J. Harris of Cambridge, is still the chief cause of preventable blindness in children in India at the present time. There were war-time outbreaks in Japan and Denmark, and it is not unknown in England even at the present day.

In some of the Continental countries to-day, certain religious feasts entail the cutting out of practically all foods containing vitamin A for two or three weeks.

The result is the development of an eye condition known as night blindness in which the person afflicted is unable to see clearly in any but a strong light. This condition rapidly disappears as soon as vitamin A-containing foods are included in the diet again. Many a girl, in following some foolish dietary regimen for slimming, has found herself with defective eyesight and dry scaly skin owing to the elimination from her diet of valuable vitamin A foods such as milk.

Vitamin D is found in many of the foods which contain vitamin A, and it in addition has something peculiar about it. Vitamin D can be formed in the skin by the action of sunlight. In the skin there is an oily substance known scientifically as "ergosterol", and when the body is exposed to ultra-violet light (the sunburn-causing factor of sunlight), this ergosterol undergoes a chemical change and it is transferred into vitamin D. Not all our vitamin D can come from this source; we must take a certain percentage of it in our food. It is present in milk, eggs, butter and cod-liver oil. Vitamin D can now be manufactured artificially outside the body. Large quantities of the oily ergosterol are placed in a bowl and irradiated by powerful ultra-violet lamps; the change to vitamin D takes place and the resultant mass is subsequently bottled and is then available to the general public.

The special function of vitamin D in the body is to look after the hard tissues. Under the direction of this vitamin the foundations of the bones and teeth are laid down, and they are finally built up to adult size with its assistance. In the absence of vitamin D from the diet, the disease known as rickets develops, in which there is malformation of bones and teeth. Minor deficiencies of the vitamin, particularly in infancy, result in the development of defective teeth and sometimes a bony condition of the bones known as sub-rickets.

The study of vitamin B has gradually been becoming more and more complicated, because it has been found that what was once thought to be a single vitamin is, in reality, made up of several vitamins; so that we now have vitamins B_1, B_2, B_3, etc. The relationship of many of these divisions of vitamin B to human nutrition is rather obscured at present. I will deal principally with vitamin B_1. This is found in green vegetables, wholemeal bread, brown rice, wheat germ, yeast and marmite. It has recently been made artificially in the laboratory. The absence of vitamin B_1 from the diet results in a disease known as beri-beri. This affliction is prevalent in the East Indies, Japan, Siam, etc. Wherever polished rice is the principal food beri-beri seems to appear in the population. The sufferer has heart trouble, and rapidly becomes exhausted and paralysed. Wasting of certain nerves causes what is described as peripheral neuritis. With slight deficiencies of vitamin B_1 in the diet the first organ affected is the heart. Other symptoms of slight vitamin B_1 deficiency may be chronic indigestion, constipation and neuritis. It has recently been found that the disease pellagra believed to be due to deficiency of one of the vitamin B group vitamins can be cured by a substance called "nicotinic" acid.

Vitamin C occurs in oranges, lemons, pineapples, strawberries, potatoes, and fresh green vegetables. Green vegetables lose all their vitamins if they are cooked

with *soda or with preparations containing soda*. If vitamin C is absent from the diet, the disease "scurvy" arises. The gums become spongy and bleed easily and the teeth become loose. Bleeding takes place under the skin and into the joints. A slight deficiency of vitamin C makes a person easily susceptible to infections like colds, influenza and diphtheria, and recent work has made it almost certain that the major portion of tooth decay and pyorrhoea at the present day is due to a slight deficiency in vitamin C.

The remaining vitamin to be mentioned is vitamin E. The general idea that this vitamin is some form of aphrodisiac is quite erroneous. If vitamin E is absent from the diet of an experimental animal it is unable to bear young, but it is not quite certain how important a part vitamin E plays in human nutrition.

Reviews

"The Proper Study—"

SCIENCE sometimes seems to describe a world as remote and fantastic as any visited by Gulliver. In a book about modern physics, we find ourselves passing, between one sentence and the next, from the vast nebulae to the inconceivably small nuclei of atoms; and the crazy, through-the-looking-glass logic of quantum mechanics has the unworldly fascination of a dream. But you may remember that Alice, who was a well-brought-up Victorian child, had a store of fundamental matter-of-factness which no amount of Wonderland could destroy; and every time we switch on the radio we come in contact with the practical effects of the apparently lunatic notions of modern physics.

The aesthetic appeal of science is, in fact, an extremely minor aspect of its importance. Science is primarily a method by which man carries out his desires. Geology shows him how to find the materials he needs. Chemistry and physics teach him how to make these materials serve his purposes. Biology has two main functions: to help man preserve the health of himself and of the domesticated animals and plants on which he depends for food, and to enable him to breed types of organisms which are more suitable for his requirements.

Man's desires are not only material. He looks forward to the future of the human race, and sees, in his sons who will live after him, some sort of immortality for himself; and man would like to have some say in determining the character not only of his domestic animals, but of his own descendants.

The science of heredity has now given man considerable power to influence future generations. The effects of this power are so far-reaching that it is essential that any proposals for action in this respect should be very carefully discussed. Haldane's latest book* deals with most of the questions which are raised in eugenical proposals at the present time. It has all the freshness and clarity which we have learnt to expect from him; the exposition of Mendelism by analogy with the Spanish system of double-barrelled surnames is an example of his brilliance in popular writing. And he has the gift of finding, in the middle of a cautious

* *Heredity and Politics*, by Prof. J. B. S. Haldane, F.R.S. Allen and Unwin, Ltd. 7*s.* 6*d.*

and closely reasoned discussion, some unexpected argument of a ruthless and shocking simplicity to demolish his opponent's point of view. For instance, discussing the very important fact that the poor tend to do less well than the rich in tests of intellectual capacity, and also tend to reproduce themselves more rapidly, he writes: "My own views on the differential birth-rate are extremely tentative, but they are somewhat as follows: If the rich are infertile because they are rich, they might become less so if they were made less rich."

Another of his arguments in the same connection is equally unexpected and equally cogent. It has been urged that under our present social system the upper classes are made up of the able, who rise by their own efforts, and the infertile, whose families rise because there are fewer children in each generation to share the inheritance; in the upper classes the able marry the infertile, and have few children so that their hereditary ability is largely wasted. Haldane points out that there is an historical experiment in which the truth of this argument has been tested. "For more than a thousand years the Mohammedans in Western Asia have practised polygamy, whilst the Christians and Jews have not. Of course only the richer Mohammedans could afford a harem. We should therefore expect that the Mohammedans would on the whole be superior to the Jews and Christians in intellectual qualities, or at any rate in those qualities which make for the acquisition of wealth. In particular, a Turk should generally beat an Armenian or a Jew in a business deal. This is notoriously not the case. And because it is not the case it is to be presumed that there is some fallacy in the arguments as to the trend of our national intelligence which are drawn from the study of the differential birth-rate."

This sceptical caution in accepting plausible arguments is the dominant note in Haldane's book. He shows that the biological possibilities are much more complex than many people imagine. For instance, in discussing the relative importance of environment and heredity in determining the value of an individual or a breed, he considers two genetically different stocks in two different environments, and enumerates all the different combinations which are possible. As he says, "the enumeration is so simple that no one has ever troubled to make it". But it serves to make perfectly clear the conclusion that "the question of the relative importance of nature and nurture has no general answer, but that it has a very large number of particular answers".

Perhaps the most important point which Haldane emphasizes is that practical human genetics is not purely a biological subject. Men do not live as single individuals, but as members of a social system in which political or sociological forces are too important to be neglected. Haldane points out how, even in connection with the apparently straightforward proposal to sterilize the hereditarily defective, political factors may be largely responsible both for causing the environment in which the genetical constitution is allowed to produce an inferior result, and in judging which characters are in fact defects. But although he holds that eugenics is not a matter for biology alone, he does not suggest that the biologist can therefore excuse himself any responsibility until the political problems have been solved by some one else. "We are a part of history ourselves, and we cannot avoid the consequence of being unable to think impartially." C. H. W.

An Orientation in Science

THIS book* is intended to give a general view of Natural Science for the average public. The editor claims that a person who understands what causes his motor-car to move possesses sufficient ability to go a step farther and comprehend the principles of physics. "He can learn to understand the movements of the stars and planets, the

* *An Orientation in Science*, edited by C. W. Watkeys. McGraw-Hill. 21*s*.

nature of atoms, compounds, and bacteria, and the place of mathematics in the logic of science." The authors are eleven members of the University of Rochester (U.S.A.) Faculty. They are experts well known in the scientific world. They give their survey as developed during the past ten years at their University.

There are thirteen sections of about 40 pages each: Astronomy, Geology, Chemistry, Physics, Physical Chemistry, Mineralogy, Biology, Paleontology, Physiology, Bacteriology, Psychology, Mathematics and Scientific Method. A short introduction reviews the methods and subdivisions of Science. It summarizes scientific procedure as observation and measurement, classification, generalization, deduction and verification. The branches are abstract and concrete sciences. Logic and Mathematics belong to the first, physical and biological sciences to the others. An index of about 1500 entries, excellent paper and print, and many well-produced illustrations add greatly to the value of the book.

The chapters are impressive as showing a genuine quality, and if they all are of the same thoroughness and exactitude as those on Biology and Physiology—where the reviewer can form a judgment of his own —the book as a whole is thoroughly to be recommended.

The introduction and the section about Scientific Method overlap unnecessarily, and although most chapters contain some historical remarks in the beginning, a more profound consideration of the history of Science, perhaps in a section of its own, would certainly have added to the uniformity of the book. As it is now the essays are offered to the reader without inner connection. They could have been cemented together by showing the development of science and of its different branches side by side with other events in the course of history. Science is only one expression of the activities of human society. No "Orientation in Science" should be written without adequate recognition of the influence of historical events, which would make approach easier for the layman, and help to remove a splendid isolation. This the book endeavours to do.

H. LEHMANN

Bactria and India

THIS masterly book* will rank as one of the most brilliant achievements of British scholarship produced in this generation. Dr Tarn, already the leading British authority on the Hellenistic age, has at last turned his attention to that most exciting and difficult of all regions where Greece influenced the course of events—the region bounded on the north by the Caspian and Aral seas, on the south by Persia and the Indian Ocean, on the east by the Pamir and on the west by Parthia. Here was fashioned a vast Greek kingdom with an energy and brilliance which will stand out in world history as one of the greatest achievements of civilization. Hellenistic history has hitherto dealt with all the other regions which the successors of Alexander ruled and organized, but has neglected the Euthydemid dynasty and their Greco-Bactrian Empire. This neglect has, in the main, been due to the fact that the only evidence available consisted of coinage, a few scattered texts of uncertain merit, and a handful of inscriptions. Indian sources fail at the most important periods and Greek historians have not survived intact. Yet Dr Tarn rescues from the confused mass of material two Greek historians and evidence enough to point to the fact that poets and artists, the latter of the highest merit, worked and created in this Bactrian Empire. He maintains that the Greek rulers of the Farther East were repeating over again the story of Macedonia. "Euthydemus was Philip II, Bactria was Macedonia, the derelict Mauryan Empire was the Persian Empire and Demetrius was a second Alexander." The Greeks succeeded

* *The Greeks in Bactria and India*, by W. W Tarn. Cambridge University Press. 30*s*.

in transforming a region inhabited by semi-nomad peoples who lived mainly in open serf-villages into a region of quasi-autonomous towns and vast walled cities, by a process of co-operation with the landed aristocracy of Bactria and by converting the bulk of the population to the advantages of Greek culture and organization. The immense bulk of Greek coinage from these parts, and its very high standard of artistic excellence, are minor proofs of the success of the experiment. "The most important fact in the history of the Greek East", says Dr Tarn, "is that something not unlike the modern struggle between nationalism and co-operation was fought out two thousand years ago under the shadow of the Hindu Kush." The Greek experiment ultimately failed and collapsed into disaster. But its failure was due to external attack not to internal disruption. It might have survived for long ages but for the movements of peoples in inner Asia to which it fell a victim. "One thing", says the author, "about that story is sure: win or lose, succeed or fail, it is the story of a very great adventure."

Dr Tarn describes his great book as a "bare outline". His modesty is extreme. The book is packed with the most detailed information and indicates a depth of scholarship unique among modern historians of the Greek world. He gives us twenty-one appendixes which illustrate in fuller detail some of the events and peoples mentioned in the text. Numismatic and epigraphical evidence is here dealt with, and thorny problems of geography and topography.

In effect he recreates, as far as the evidence will permit, a clear and decisive picture of Greek activities in these now almost inaccessible places. Archaeological evidence from excavations is almost completely absent, but he uses every scrap that is available. Beyond a French expedition into Afghanistan, no attempt has been made to examine what must prove to be the rich remains of Greek settlement. The very capital of the empire itself, Bactra, is untouched. Only a mere fraction of the innumerable Greek cities are identified on the map. Few have been even examined by field-archaeologists. Yet Dr Tarn patiently builds up for us a picture both of the culture and the political history of the district. And throughout he emphasizes the fact that we cannot conceivably talk of the decadence of the Hellenistic world as long as we have so magnificent an example of Greek creation before us. As he points out, we have only to glance at the portrait of Euthydemus of Bactria, which survives both in a marble head and on countless coins which show him from middle to old age, to realize that he was a very great man. Demetrius also had the qualities of an Alexander.

Coin portraits of (1) *Euthydemus in old age*, (2) *Euthydemus on a pedigree coin of Agathocles*, (3) *Demetrius*

Dr Tarn has made the most notable contribution to Greek historical studies in our generation. His work stands alone. There is no other in any language. It will serve all scholars and students for many decades to come. And if and when excava-

tion reveals the material remains of the Bactrian Empire, Dr Tarn's book will still stand as the firm historical background against which those remains must be interpreted.

The publishers are to be congratulated on producing at so moderate a price a masterpiece of patient and critical scholarship. S. C.

Teach Yourself to Think

OUT of the apophthegm "He that will not reason is a bigot; he that cannot reason is a fool; and he that dares not reason is a slave", R. W. Jepson has provided a concise and useful book* on the necessity of clear, deliberate thought. Attributing many of the present-day complications to an incapacity for clear thinking, the author deals carefully with the problem of propaganda. In this little book he emphasizes the importance of independent thought, pointing out, by patient and obvious examples, arguments and reasons why we must insist upon thinking things out for ourselves and refuse to adopt ready-made opinions.

* *Teach Yourself to Think*, by R. W. Jepson. English Universities Press. 2*s*.

Select List of Books Received by Discovery

(*Mention in this list does not preclude review*)

In Search of the Mahatmas of Tibet. E. G. SCHARY. (Travel Book Club. 3*s*. 6*d*.)

This Modern Age. F. C. HAPPOLD. (Christophers. 4*s*.)

Teach Yourself to Think. R. W. JEPSON. (English Universities. 2*s*.)

Light on Exposure Problems. PHILIP C. SMETHURST. (Acweeco Ltd.)

The Behaviour of Animals. E. S. RUSSELL. (Edward Arnold & Co. 10*s*. 6*d*.)

Science and Nutrition. A. L. BACHARACH. (Watts. 2*s*. 6*d*)

Urmass und Schöpfung. V. SCHOEN-WILDENEGG. (Schoenfeld Verlag. R.M. 780.)

The Perception of Light. W. D. WRIGHT. (Blackie. 6*s*.)

The Nature of Man. ELIE METCHNIKOFF. (Watts. 5*s*.)

A Manual of Radioactivity. GEORGE HEVESY and F. A. PANETH. (Oxford University Press. 17*s*. 6*d*.)

The Will to Civilisation. JOHN KATZ. (Secker & Warburg. 12*s*. 6*d*.)

The Flight of Birds. C. HORTON SMITH. (Witherby. 7*s*. 6*d*.)

The New Immortality. J. W. DUNNE. (Faber. 3*s*. 6*d*.)

Peaks and Valleys. F. S. SMYTHE. (Black. 12*s*. 6*d*.)

Animal Life in Fresh Water. HELEN MELLANBY. (Methuen. 8*s*. 6*d*.)

Advanced Experiments in Practical Physics. J. E. CALTHROP. (Heinemann. 8*s*. 6*d*.)

Ferromagnetism. J. R. ASHWORTH. (Taylor & Francis. 7*s*. 6*d*.)

Patagonian Year. PEDRO RUBIO, translated by ARTHUR G. CHATER. (Methuen, 7*s*. 6*d*.)

Whitfield King's Standard Catalogue of Postage Stamps, 1939. (5*s*.)

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